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EDITORIALS

Intensive Nursing Care

HOSPITALS throughout the country have been faced with a shortage of registered nurses during a period when increased demands have been made for hospital care. In some hospitals the shortage of nurses has been sufficiently acute to require the closing of nursing units or operating rooms. Surgeons have recognized many of these difficulties and the need to participate in studies of means to alleviate this problem. At the same time that hospitals have been faced with a shortage of registered nurses, the demands for skillful nursing care have increased, particularly in the field of surgery because of the increased number of operative procedures and the greater complexity of surgery. The expansion of cardiac surgery is an example of the latter.

The development of recovery rooms, or post-anesthetic care, was stimulated in large part by the shortage of nurses. The success of this concept of nursing care in the management of surgical patients has been widely accepted. However, this type of care provides adequate nursing attention for only the first few post-operative hours. This is sufficient for many patients who have operations of lesser magnitude. However, continued skillful nursing care is required for patients with complicated or serious surgical problems or severe injury. In the past, private duty nurses were available to render the close attention that such patients require. Presently hospitals are hard-pressed to supply individual attention and unable to provide private duty nurses in many instances.

The continued shortage of nurses and increased demands upon hospitals has led to a number of considerations to meet this problem, and the concept of intensive nursing care has grown out of these studies. Considering the pertinence of this to surgeons, the following discussion will analyze the potential of this concept and its possible attributes. It should be understood that intensive nursing care is not a single or uniform method but a concept that is being tried in various hospitals in different ways. This is distinct from recovery room care and is for the patient who requires continued special attention after leaving the recovery room. However, the purpose of an intensive care unit is related in principle to recovery room care. The unit is designed to concentrate patients who are seriously or acutely ill in a functional area, so they may have the benefit of skilled nursing care with the necessary ancillary equipment readily available. With this thesis, two general types of intensive nursing care have appeared. In one, a physically separate area has been developed: the intensive nursing unit. In other hospitals, the formation of a nursing team which provides intensive care for special problems anywhere in the department of surgery has been undertaken.

The intensive nursing unit is best designed to accomodate four to six patients in each unit. There has been some divergence of opinion concerning the types of patients who are admitted to such a unit. In some units, seriously ill patients are admitted for intensive nursing care regardless of their diagnosis. Thus patients would be found in these units with acute injuries, acute coronary occlusion or after surgical procedures. In other hospitals, only surgical patients are admitted to this special unit. One of the better known projects has been

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the development at the Manchester Memorial Hospital in Connecticut where the intensive care unit is part of a program of progressive patient care.* Patients are admitted to this intensive care unit when they are seriously ill from sudden gastrointestinal bleeding, acute cardiac conditions or following major operations. Nursing is provided only by those nurses assigned to the unit, and private duty nurses are not permitted to work in the area. The average stay of the patients in the unit is a little over five days.

The organization of an intensive nursing care team provides similar concentrated nursing attention, but a special area within the hospital is not set aside. Rather the team goes to the patient area. Such nurses require training comparable to that given to the recovery room nurses so that they are prepared for postoperative emergencies or critical situations which are associated with major surgical procedures. These nurses are under the direction of the nursing department as are other staff nurses, and are assigned to seriously ill patients or to those that have special nursing problems, such as patients who have undergone cardiac surgery.

The concept of intensive nursing care appears to be sound and seems to be necessary in some form at the present time. In the past, special care has been provided by private duty nurses who are diminishing in number throughout the country. In one area in the country where an average of 11.5 private duty nurses had been available on a twenty-four–hour basis, it was found in 1958 that the average had dropped to less than two [1]. Wherever the concept of intensive nursing has been applied, better utilization of nurses seems to have occurred. It has been pointed out that such a unit or team may not reduce the nursing shortage for the particular hospital staff because additional nurses are required to establish the unit. This may actually increase the shortage of staff nurses acutely [2]. However, the need for private duty nurses is reduced. This, in turn, does alleviate the nursing shortage in the community.

Intensive nursing care provides assurance of the type of attention that seriously ill patients will receive. It seems to enhance nursing morale because other staff nurses are able to distribute their time more equitably among patients who are less acutely ill.

Financial considerations enter into the establishment of these units. If a physically separate unit is planned, it must be realized that a duplication of facilities, equipment and staff is required. Furthermore, the hospital assumes the role of providing special nursing care rather than having the patient charged directly for private duty nurses. For this reason the charge for a stay in an intensive nursing unit has generally been in excess of the standard hospital charge for the usual room to which the patient has been admitted.

The type of intensive nursing plan which is instituted requires study of the needs of the particular hospital. In the community hospital, the allocation of a special unit for this purpose seems wise and is to be encouraged. It has been stated that 65 per cent of the community hospitals in the United States have fewer than 100 beds and that these hospitals provide approximately 24 per cent of the general hospital beds in the country [3]. The intensive nursing unit is particularly well suited for this type of hospital.

In larger institutions, particularly those in which training programs are well established in the special fields of medicine, there may be considerable justification for reluctance in the establishment of special units as physically isolated areas within the hospital. Here the resident staff plays an active part in the supervision and observation of the patients who are critically ill. The nursing program is integrated with the training program in the specialties. The volume of serious and complicated problems makes the operation of a unit devoted to this special type of care extremely difficult. It would appear that the concept of special teams of nurses is a much more practical method of introducing intensive care under these circumstances.

* Progressive patient care has been described as graded nursing care which includes intensive care, intermediate care, self-care, long term care and organized home care. (Abdellah, F. O. and Strachan, E. J. Progressive patient care. *Am. J. Nursing*, 59: 649, 1959.)

[1] Symposium on progressive patient care. *Hospitals*, 33: 43, 1959.

[2] Wagner, R. A. How does the intensive care unit affect nursing morale and utilization? *Nursing Outlook*, 6: 286, 1958.

[3] Haldeman, J. C. and Abdellah, F. O. Concepts of progressive patient care, parts I and II. *Hospitals*, 33: 38, 41, 1959.

The physical structure of hospitals may at times influence the introduction of intensive care units. It would seem wise to consider the introduction of such a unit into the design of new hospitals. The American Hospital Association has recommended that one bed be set aside for intensive care for every twenty to twenty-five beds in use in the hospital.

As special care units have been developed, special problems have arisen to which some thought must be given. Lack of privacy and mixing of sexes has been a problem in some. In contrast to the recovery room, where the patients' senses are still somewhat dulled from the effects of anesthesia and operation, the patients in the intensive care unit are often aware of their surroundings. The efficiency and effectiveness of the unit depends upon the ability of the nurse to observe the patients at all times and upon having a unit of four to six occupants. This makes privacy difficult and raises objections from some patients.

Another problem has arisen in some hospitals when a patient is ready for transfer from the special care unit. In hospitals where the bed occupancy is high, it has been expedient, from the administrative standpoint, to admit a patient to the bed on the floor that has been vacated by the patient who has been sent to the intensive care unit. In the face of a high hospital census, it may be difficult to find an empty bed to which the patient in the special unit may be sent. In one West Coast hospital it has been necessary to keep patients in the intensive care unit for an additional two or three days until a vacant bed has been found elsewhere in the hospital. One metropolitan municipal hospital has solved this problem by keeping the patient's space unoccupied in the ward while the patient is in the special care unit. This does not seem practical for most private institutions. However, the prolonged retention of a patient in the intensive care unit is undesirable from the patient's standpoint. It is psychologically disconcerting as well as a financial burden.

It has also been recommended that at least one vacant bed be held in intensive care units for an emergency case. Where the volume of surgery is great and the magnitude of the operations is proportional, this may raise significant problems. It may reach the point of requiring the transfer of a patient from the unit before he is actually ready to be released from the close observation that the unit provides.

Consideration of the patient's family enters into the arrangement of these units. As in the recovery room, visiting must be restricted. In the intensive care unit, provision must be made for limited visits by relatives or the immediate family which is usually not allowed in recovery rooms. Provision must be made for contact with the families, and an appropriate waiting room is required.

The principles upon which intensive nursing care is founded are sound. It is a logical result of the problems which have arisen from the shortage of registered nurses in an era when demands for better care by the medical profession are increasing. The development of this type of care has been largely the result of the efforts and study by the nursing profession and hospital administrators. It is important that the medical profession play a more active role in the further extension of the concepts that are evolving in this area. The surgeon is particularly influenced by the nursing care that is afforded to patients after surgical procedures or after acute injury. Ultimately, teaching of medical students and the training of resident physicians and surgeons will be affected. The needs of the particular hospital are important in the development of the program, and the physician must play an active role.

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Let's *Look* at the Record

On a sultry autumn afternoon ten years ago the tumor clinic of a large university teaching hospital was in session. A surgical resident rose. Without recourse to the chart, he began to relate the history of Susie X who had "female troubles." At the appropriate moment he stated, " . . . and the pathologists said she had cancer." The assembled physicians began to debate the merits of Wertheim's hysterectomy versus radiotherapy. A vote was in the offing. The staff pathologist in attendance (myself) screamed in anguish, "Wait! This patient does not have cancer! Let me read the biopsy diagnosis. 'Squamous metaplasia of cervix with atypical foci suggestive of intraepithelial carcinoma. Recommend re-biopsy.'" This was my first contact with a fundamental phenomenon, which has since been observed repeatedly on numerous occasions. This may be stated as follows: "*Pathologic diagnoses, like gossip, inevitably become more malignant when passed from mouth to mouth.*"

Since then, it has been my standard practice never to give serious credence to a verbal report of a pathologic diagnosis. A verbal report is only an indication to check the actual written report. The distortion is always in the direction of malignancy. House officers are trained to give clinical summaries at conferences from memory. This probably has real merit as a general teaching procedure. However, the pathologic diagnosis should always be read word for word. This is especially important if a tumor clinic is in session, and a vote or decision affecting the patient's treatment is in prospect.

The patient's memory of his diagnosis may also be in error. Recently, a woman told a member of our staff that a biopsy which had been performed elsewhere showed cancer of the cervix but the doctors wanted to sew it up and watch it for awhile. When the pathologist's report was obtained it read much like the one quoted previously: "Atypical hyperplasia of the cervix with foci of intraepithelial carcinoma. Suggest conization."

The modern practice of medicine is in part a problem of communication between co-workers. Each must understand the other's meaning exactly.* Misconceptions and misquotations may be to the patient's detriment. At least as far as pathologic diagnoses are concerned, we earnestly recommend that reliance upon memory and verbal reporting be avoided. The exact wording of the pathologist's report is of utmost importance. "Let's *look* at the record."

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* Foraker, A. G. On the importance of "weasel words" in surgical pathology. *Surg., Gynec. & Obst.*, 105: 637, 1959.

A Simple, Rapid Screening Test for Serum Amylase

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A HIGH value for serum amylase is widely regarded as the single most important laboratory finding to help establish a diagnosis of acute pancreatitis. At a recent panel discussion on the topic of pancreatitis [1], it was the consensus that the result of a test for serum amylase was as useful as that of a leukocyte count in evaluating the problems of undiagnosed acute abdominal pain. Yet, many institutions have no facilities for performing a test for serum amylase on an emergency basis; the usual method of determination is time-consuming and requires highly skilled personnel.

During the last six years we have successfully used (in approximately 4,000 cases) a modification of a procedure described by Sachar [2]. This method of determining the serum amylase can be completed within twenty minutes, requires a minimum of equipment, and is easily taught to interns, residents and night laboratory personnel. (Fig. 1.)

REAGENTS AND THEIR PREPARATION

The materials needed are starch substrate and iodine solution (0.002N). They are prepared as follows:

Starch Substrate

Buffer salt solution, pH 6.8: Dissolve 3.81 gm. of anhydrous potassium dihydrogen phosphate in 300 ml. of distilled water. Add 8.38 gm. of anhydrous disodium phosphate to this solution, and stir it until it is dissolved. Finally, add 14.61 gm. of sodium chloride; stir it until it is dissolved, and dilute the resulting solution with distilled water to 500 ml.

Starch solution, 2 mg./ml.: Weigh out 1.1 gm. of soluble starch (prepared commercially "according to Linter"); suspend it in 10 ml. of cold water; add approximately 100 ml. of boiling water and bring it to a boil; cool the solution, and dilute the suspension to 500 ml. with distilled water. This suspension will approximate 2 mg. of starch per milliliter with a probable error no greater than 10 per cent, and it is acceptable for a screening test.*

Combine the equal volumes (500 ml.) of the buffer solution and the starch solution and mix well: One liter of starch substrate is sufficient solution for performing 165 tests. Tubes for the individual tests are conveniently prepared at this time, in the following manner: Use a pipet to place 6 ml. of the starch substrate into a 15 by 150 mm. test tube; then use cotton to stopper the tube. Place the tube in a test tube rack in a bath of boiling water for

* If greater accuracy is desired, this starch suspension should be analyzed further at this point, and a more accurate solution prepared. The anthrone procedure [3] may be used for this analysis. Dilute an aliquot of starch to a concentration of from 3 to 30 μg./ml. Place 5 ml. of the dilute starch solution in a test tube, and cool it in an ice bath for five minutes. Then add 10 ml. of freshly prepared 0.2 per cent anthrone in 95 per cent sulfuric acid. Mix; cover the test tube with an ordinary glass marble, and heat for ten minutes in a boiling-water bath. Cool in cold water and read at 620 mμ against a blank prepared in the same way with distilled water and anthrone. Standards are made from pure glucose and water: 1 mg. of glucose is equivalent to 0.9 mg. of starch.

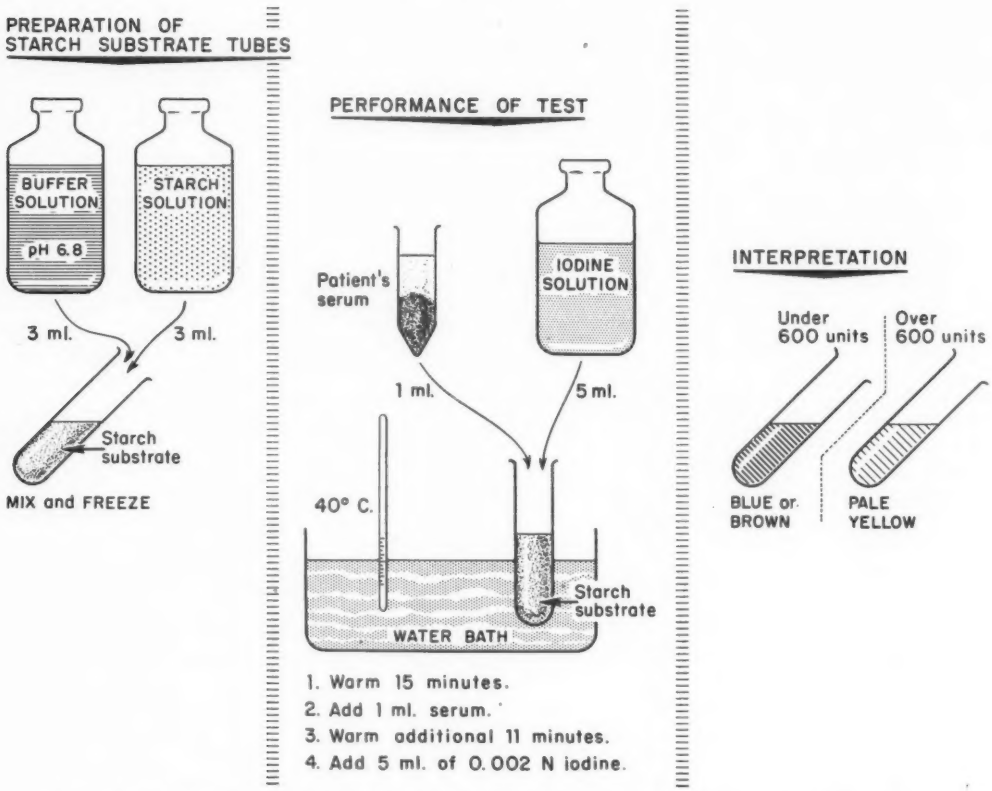

FIG. 1. Screening test for serum amylase, showing steps in preparation, performance and interpretation.

fifteen minutes; cool the tube and then store it in a freezer.

Boiling and freezing are necessary to prevent possible action of microorganisms. (A method of chemical preservation is under consideration: 1.35 gm. of methylparahydroxybenzoate and 0.27 gm. of propylparahydroxybenzoate per liter of starch solution.*)

Iodine, 0.002N

Dilute 2 ml. of 0.1N iodine and potassium iodide solution to 100 ml. (This solution must be prepared every two weeks and must be stored in a dark bottle.) Approximately 0.1N iodine is prepared by triturating 1.3 gm. of iodine crystals and 4 gm. of potassium iodide with water. Dilute the solution to a final volume of 100 ml.

* Available from Heyden Chemical Corporation, New York, New York.

METHOD OF PERFORMING TEST

1. Remove a tube of buffer salt and starch solution from the freezer; warm it in water until the contents are thawed, then place the tube in a water bath of 37°C. for about ten minutes, or until the temperature of the contents of the test tube is 37°C. A second tube with normal serum should be set up as a control.

2. Add 1 ml. of the patient's serum to the first test tube; mix by shaking well. Incubate the tube at 37°C. for exactly eleven minutes.

3. Remove the tube from the water bath and add 5 ml. of 0.002N iodine. The color of the mixture will be an index of amylase content. If the mixture turns blue or brown, the amylase value is less than 600 amylase units. If it turns pale yellow, the value is more than 600 amylase units.

A value of 600 units of serum amylase is

accepted as an arbitrary dividing line in our laboratory, where 200 units is considered approximately the upper limit of normal. We believe that values higher than 600 units are of unquestioned significance, and hence are a guide to the diagnosis of acute pancreatitis.

CASE REPORT

A forty-nine year old coal miner was suspected of having cancer of the pancreas, but possible chronic pancreatitis had to be ruled on. At surgery a tumor was found in the head of the pancreas. Strands of fibrosis, and hard, grey nodules in the liver showed no carcinoma in a biopsy specimen. A Vim-Silverman needle biopsy of the head of the pancreas was made through the duodenum, and one of the specimens showed adenocarcinoma on frozen section. An existing cholecystenterostomy which had been performed at another hospital was not disturbed.

During the first night following operation, severe tachycardia developed (a pulse rate up to 140). A rapid serum amylase determination was made, and it indicated a value of more than 600 amylase units. Postoperative pancreatitis was diagnosed (consistent with the manipulation of the pancreas during surgery), and the patient promptly received plasma and other supportive measures. Subsequent serum amylase determinations performed according to our regular method [4], were 1,920 units, 1,760 units and finally, on the seventh postoperative day, 360 units. Except for a minor wound infection, the patient made a good recovery and was discharged from the hospital on the eleventh postoperative day.

Comment: The rapid serum amylase determination made at night permitted a definitive diagnosis to be made, followed by appropriate treatment, at a time when regular laboratory personnel were not available. The high serum amylase value obtained by the rapid method was subsequently corroborated by standard methods of determination.

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Postoperative Chylothorax

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TRAUMATIC chylothorax, as recently as 1945, was an uncommon operative complication. With the tremendous surge of intrathoracic operations upon the cardiovascular system since that time, this has become a relatively common complication, and one that requires an awareness of its incidence and prompt, definitive treatment.

ANATOMY

Most commonly, the thoracic duct enters the chest through the aortic hiatus of the diaphragm and ascends to the right of the midline in the posterior mediastinum, between the azygos vein and the descending aorta. The duct continues along this course to the level of the aortic arch, at which point it crosses to the left. In most instances it passes anteriorly to the left subclavian artery into the neck, where it terminates, usually draining into the left internal jugular vein. Variations in the portion of the duct below the fifth thoracic vertebrae are relatively uncommon, although double channels have been described [8]. Variations in the upper thoracic portion are relatively frequent [4]. The duct was found to cross posteriorly to the left subclavian artery in about one-fourth of the cadavers studied, and has been described as continuing into the neck on the right side. Tributaries into the main thoracic duct are widely scattered and complex. Those most commonly encountered in cardiovascular procedures are the channels associated with groups of lymph nodes frequently found adjacent to the vagus nerve at the level of the ductus or ligamentum arteriosum. The incidence of chylothorax occurring on the right side with Blalock-Taussig operations performed on the right side suggests that more anatomic variations may occur with the right aortic arch that frequently accompanies a tetralogy of Fallot.

INCIDENCE

Maloney and Spencer [6] reported thirteen cases of chylothorax in 2,660 thoracic cardiovascular operations, an incidence of 0.5 per cent. Our experience is comparable, with six cases of chylothorax occurring in approximately 1,000 operations. In the vast majority of the cases reported, chylothorax followed operations which involved dissection about the subclavian artery, particularly anastomoses between the pulmonary and subclavian arteries, correction of coarctation of the aorta, and division or ligation of patent ductus arteriosus. Two of our cases involved the use of the left subclavian artery as a site for inflow from a pump-oxygenator. Baffes and Potts [1] reported cases following correction of a vascular ring and excision of a cystic hygroma involving the upper mediastinum and apex of the left pleural cavity. Maloney and Spencer [6] reported chylothorax on the left side following Brock pulmonary valvulotomy. Chylothorax occurring after pulmonary resections and operations upon the esophagus is inexplainably rare, especially in view of the extensive mediastinal dissection necessary for esophagectomy.

PREVENTION

Little can be advised in regard to the prevention of injury to the thoracic duct and its tributaries. Lymphatic channels can be recognized frequently during the course of dissection about the great vessels, and should be avoided or ligated. The recognition of chylous leakage in the operative field demands a search for the site of injury and ligation of the duct if it can be found. However, chylothorax has occurred following a procedure in which a leaking lymphatic

duct had been specifically visualized and ligated [7]. A temporary Horner's syndrome has been observed by us following ligation by suture of a lymphatic duct injured during dissection of the distal intrathoracic portion of the left common carotid artery for coarctation of the aorta.

Cohn and his associates [2] describe a technic for the routine visualization of the thoracic duct at operation by the injection of direct sky blue stain into the wall of the esophagus. While this maneuver has merit on theoretical grounds, it is unlikely that many surgeons will employ the technic routinely in cardiovascular procedures.

CLINICAL MANIFESTATIONS

In most cases reported, and in all but one of our patients, the appearance of chylothorax has been manifested only by the accumulation of fluid in the pleural cavity, with minor or no symptoms. Notable exceptions to the lack of symptoms appear to be in the cases of small children and infants, in which reduction of pulmonary capacity is of relatively greater consequence, and the loss of fluid, calories and proteins is more likely to be of critical proportions.

The relatively late appearance of the accumulation of fluid has been noted by us and other observers. Baffes and Potts [1], however, report three cases in which the chyle was noted to be draining from an intercostal catheter immediately after operation, two cases in which draining occurred on the day of operation and one in which it occurred the following morning. More frequently, fluid has been seen by x-ray film or physical examination three to ten days postoperatively, after removal of the routinely employed water-sealed intercostal catheter.

Fever usually is not a prominent feature in patients with chylothorax, and gross infection with empyema has not been reported. Chyle appears to be bacteriostatic, and the low grade fever which occurs occasionally in these patients is probably associated with atelectasis and pneumonitis in the compressed lung rather than reaction to the chyle.

Meade and his associates [7] describe an inflammatory pleural reaction to the chyle with pleural thickening and fibrin deposition, which in one case required decortication for expansion of the underlying lung. This was not the case, however, in one of our patients operated upon fourteen weeks after the initial procedure. At operation for closure of the chylous fistula, the lung re-expanded promptly upon removal of the fluid. Maloney and Spencer [6] operated upon a patient in whom a fistula had been present for one year, and they report no fibrothorax requiring decortication at that time.

DIAGNOSIS

Thoracentesis and the gross characteristics of chyle have been adequate to establish a diagnosis of chylous fistula in our six patients and in most of the cases reported in the last ten years. Detailed characteristics of the fluid are as follows: (1) milky appearance; (2) creamy layer if allowed to stand; (3) finely emulsified fat globules which stain with Sudan III dye and dissolve in ether; (4) no odor; (5) alkaline reaction; (6) specific gravity above 1.012; (7) the fluid is sterile and resists bacterial growth; (8) the fat content is high, 0.4 gm. per cent; (9) total solids are greater than 4.0 gm. per cent; (10) total proteins are 3.0 gm. per cent.

For confirmation of the diagnosis of chylothorax, Klepser and Berry [5] describe a simple test involving the oral administration of a fat meal containing a lipophilic dye (D and C red No. 17 or 18, D and C green No. 6), followed in several hours by thoracentesis to demonstrate fluid grossly discolored by the dye. We have not found it necessary to use this test for diagnosis, but certainly it might be helpful in doubtful cases.

TREATMENT

The earlier methods of treatment of chylous fistula, such as crushing of the phrenic nerve, pneumothorax, thoracoplasty, and x-radiation, are of historic interest only. It is also of historic interest that as recently as 1945, the mortality in treatment by aspiration was reported to be 50 per cent, and by operation 100 per cent [3]. It is apparent from recent reports and our own experience that chylothorax can be managed effectively in the vast majority of patients, if not in all patients, without significant mortality. The problem, after diagnosis, has then been resolved into one of determining a plan of management which will effect closure of the fistula with safety and the least morbidity.

There is general agreement that patients with chylothorax should have an adequate trial period of non-operative management, consisting of thoracenteses as often as indicated by the

reaccumulation of fluid, drainage by water-sealed intercostal catheter if necessary to insure adequate expansion of the lung, and appropriate supportive therapy to replace the loss of fluid, calories and proteins. Operative control of the fistula should then be undertaken if non-operative measures fail. In most instances, the determination of what constitutes an "adequate" trial of non-operative treatment is the outstanding problem, and there is a justifiable reluctance of most surgeons to subject a patient in the immediate postoperative period to a second thoracotomy if it can be avoided.

Our experience and that of others has demonstrated that the majority of patients with chylothorax can be safely and effectively treated by multiple thoracenteses, and it is likely that the earlier application of closed catheter drainage will effect obliteration of the pleural space and adherence of the lung more quickly than will aspiration. Persistence in non-operative therapy, therefore, up to three weeks or longer would seem to be justified in older children and adults, in whom maintenance of nutrition and hydration and adequate pulmonary function can be accomplished without undue difficulty. In small children, however, and especially infants, inadequate pleural drainage with lung compression, and difficulties in supportive therapy in the face of excessive loss of fluid, calories and proteins should indicate the need for early consideration of operation without procrastination.

The operative approach to a chylous fistula requires clarification. In 1954 Klepser and Berry [5] suggested that operation should be performed through a right thoracotomy incision regardless of the side of the effusion, since the main thoracic duct can be most easily isolated and ligated from the right side as it enters the chest through the diaphragm. Even though most fistulas will be controlled in this manner, this approach does not seem logical. With a chylothorax and recent thoracotomy incision on the left side, curtailment of the function of the right lung by thoracotomy is distinctly undesirable. In addition, recent experience indicates that in most instances the site of leakage can be visualized and sutured definitively. Therefore, exploration for a chylous fistula should be performed on the side of the chylothorax, with the purpose of locating and controlling the fistula.

Aids to localization of the fistula include the preoperative oral administration of a fatty meal or lipophilic dyes, and injection of direct sky blue stain into the wall of the esophagus at operation, as suggested by Cohn and his associates [2]. It has seemed desirable to us to avoid the staining of tissues with dyes which may further obscure the fistula. In one of our two patients on whom operations were performed, the subcutaneous injection of normal saline solution as advised by Dr. C. B. Taylor effected a marked increase in the outpouring of fluid through the fistula, making identification of the site of leakage relatively easy. In the event that the fistula on the left side cannot be identified, it is still feasible to locate and ligate the main thoracic duct from the left side, even though this may require more dissection than does its localization through a right thoracotomy incision.

SUMMARY

With the increase in thoracic operations upon the heart and large vessels, traumatic chylothorax has become a relatively common postoperative complication, demanding an awareness of its incidence and a sound plan of management when it occurs. The anatomic location of the thoracic duct is described, and a knowledge of the variations in its course and tributaries is emphasized. The incidence of chylous fistulas following cardiovascular operations is approximately 0.5 per cent. These fistulas occur most commonly following operations requiring dissection about the subclavian arteries.

The clinical manifestations of chylothorax and characteristics of the fluid are described in detail.

Treatment should consist of an adequate trial of non-operative management by thoracentesis, closed catheter drainage, and suitable supportive therapy, reserving operation for those patients who cannot be managed non-operatively. Small children and infants are most likely to respond poorly to non-operative management and may require earlier consideration of operative intervention.

Operation should be performed on the side of the chylothorax and an attempt made to locate the site of the fistula for definitive closure. Location of the fistula may be aided by the subcutaneous administration of normal saline solution to increase temporarily the flow of chyle without the staining of tissues.

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Anorganic Bone Grafting*

CLINICAL EXPERIENCES WITH HETEROGRAFTS PROCESSED BY ETHYLENEDIAMINE EXTRACTION

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THE organic fraction of bone may be removed by extraction with ethylenediamine. The resulting osseous product ("anorganic bone") consists largely of the crystalline, mineral, latticework of bone. It is a white, porous, fragile substance, which can be shaped with a scalpel to fit precisely the contours of any bone defect. It may be stored at room temperature for long periods of time without decomposing. (Fig. 1.)

The development of anorganic bone was based on the hypothesis that the biologic failure of certain bone grafts is due to the response evoked by organic contitutents, i.e., proteins, fats, mucopolysaccharides, etc. Working on this basis, extraction of these fractions was accomplished by exposing the bone to the action of ethylenediamine, a strong alkaline organic solvent. Ethylenediamine was cycled over the bone in a Soxhlet extraction apparatus using the method of Williams and Irvine [*32*], as modified by Losee [*18*].

Experiments conducted on animals at the Naval Medical Research Institute (Bethesda, Maryland) over a period of four years demonstrated that this material was accepted by the host without localized inflammatory reaction. The marrow-vascular spaces of the anorganic bone implants were rapidly invaded by osteogenic tissue from the host [*16,20*].

Although the normal cycle of graft remodeling and removal seemed to be slower with the bone extracted with ethylenediamine than with non-extracted auto- and homografts, the evidence was favorable enough to justify a limited clinical use in man. (Figs. 2 to 4.) The

FIG. 1. Orthopedic carpentry possible with anorganic bone. This white, porous substance may be shaped with a scalpel to fit precisely the contours of any bone defect.

TABLE 1
CLINICAL EXPERIENCE WITH HETEROGRAFTS PROCESSED BY ETHYLENEDIAMINE EXTRACTION

Type of Procedure	No. of Patients
Femoral neck fractures fixed with Smith-Petersen nail (experimental group)	5
Bone defects (bone cysts, enchondroma, etc.)	9
Reconstructive procedures (arthrodesis, etc.)	9
Spinal fusion, L5/S1 and L4/S1	30
Cranioplasty	6
Cranial burr holes (300 implants)	90
	149

* This study was supported by Research Grant NONR 266 (*52*), from the Office of Naval Research, Department of the Navy, Washington, D. C.

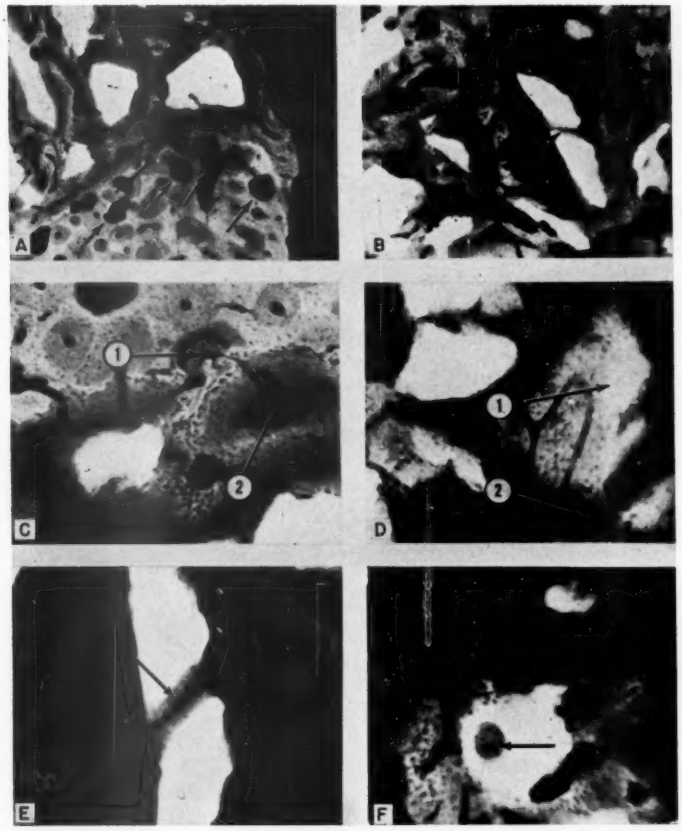


FIG. 2. Microradiograms of 50 micron sections of bone. Pictures are exposed on Kodak maximum resolution plate and enlarged by photomicrography. White areas contain large amounts of mineral salts. Organic material in sections does not show up in comparison with mineral salts. Cross sections are through graft site in tibia of a dog. Cortical defects measuring 2 mm. by 5 mm. were grafted with heterologous anorganic bone chips (20 mesh) made from dense bovine cortical bone. Animal was sacrificed after chips had been in place nine weeks. A, low power view illustrates quantitative distribution of mineral salts throughout host (lower half) and donor structure (upper half). Vertical delineation passing from lower left-hand corner of photograph upward toward right-hand corner represents edge of saw cut. Arrows indicate resorption cavities, result of a localized hypermia in host. B, low power view reveals structural relationships of callus formation of host and donor. X-ray–absorbing structures appear white. Arrow points to region of grafted chip which has been vascularized. C, high power view of cross section of edge of defect. Haversian systems of host (upper area) have varying amounts of mineral salts (darker in picture). Haversian system (1), cut in half by saw blade, hemorrhaged into space (2). Callus developed around this space forming a primitive osteon. Vascular connection between Haversian canal and sinus space remains. D, high power view illustrates mineral bonding between donor bone (1) and host callus (2). Multiple black-dotted areas represent lacunae occupied by osteocytes, which permit passage of x-rays. E, high power view of (B) illustrates area of perivascular reaction (arrow). Lesser degree of mineralization could either result from absorption of mineral salts of graft or accretion of new bone. Presence of osteocytes would indicate this effect to be result of latter. F, high power view of cross section of portion of chip graft which has been revascularized, similar to those depicted in (B) and (E). Microradiogram again illustrates lesser degree of mineralization in perivascular area. Spaces for osteocytes are seen as transparent areas on x-ray film.

use of anorganic heterogenous bone in the treatment of oral bony defects in man has been reported separately by Bell, Hinds and Arnim [*4*], Hayward, Costick and Avery [*12*], and Boyne, Lyon and Losee [*5*].

This report presents a preliminary account of experience with anorganic bone in surgical procedures performed on 149 patients whose progress was followed up from five months to two years.

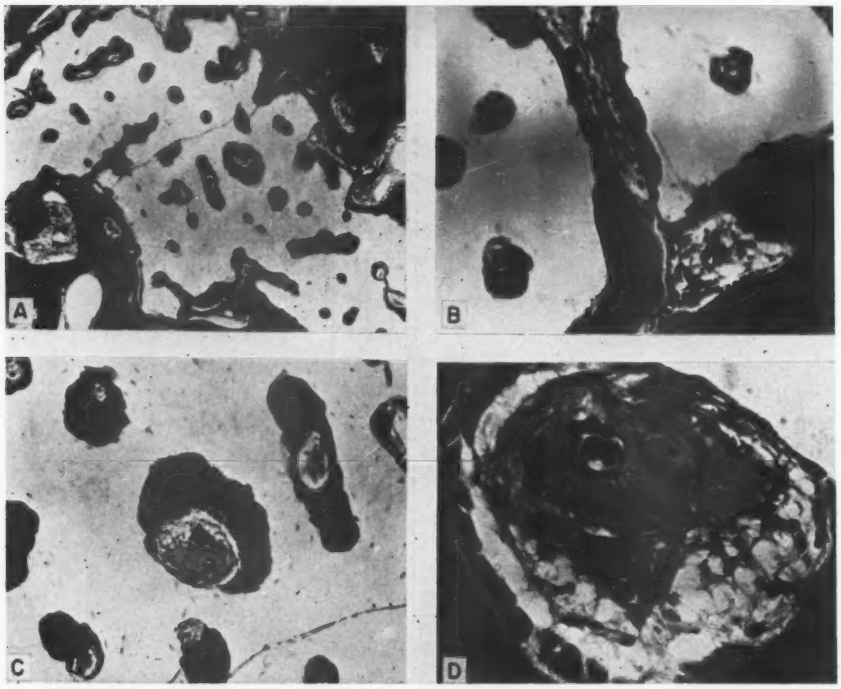


FIG. 3. Heterologous anorganic bone graft, cow to dog (dense cortical bone from femur). At six weeks sections were decalcified, embedded in celloidin, and stained with hematoxylin and eosin. A, low power view illustrating degree of remodeling that has occurred since time of transplantation. Picture is not obscured by presence of organic matrix of donor. Inorganic matrix was removed in preparation of slide (decalcification) leaving areas which appear as empty spaces. B, high power view illustrating sheet of perivascular new bone which extends from host into graft. C, high power view illustrating primitive Haversian system (osteon) containing an arteriole, venule lymphatic and undifferentiated mesenchymal connective tissue. D, high power view of photomicrograph of osteon depicted in (C), showing formed elements within canal, all of which grew into graft in six weeks. Note arteriole, thick-walled venule (containing red cells) and lymphatic (clear lumen). Osteoblasts are characteristically arranged in one-cell thick pseudoepithelium, carpeting surface of newly formed trabecula of bone matrix.

CLINICAL STUDIES

The type of procedures in which anorganic bone was used and the number of patients evaluated are summarized in Table 1.

As a basic criterion for these clinical studies, anorganic bone was employed only in procedures in which it was in contact with a large, raw, osseous surface capable of producing an osteogenic response of sufficient degree to engulf and remodel the graft. Basically, it was intended that the implants serve as a temporary scaffolding or histologic template. In addition, it was proposed that the potential space in which osteogenesis could occur would be increased, since the implant would function mechanically to elevate the differentiated soft tissue from the raw osseous bed. Anorganic bone was not used when internal fixation was required of the graft, because of its extreme fragility.

When properly handled, anorganic bone has been well tolerated by the host and rapidly incorporated in reparative callus at an early stage. Only one untoward response occurred in this series of cases. If the material is too fine, a non-specific inflammatory response may be anticipated.

In five patients with fractures of the hip which were repaired by internal fixation with a Smith-Petersen nail, a block of dense cortical bovine anorganic bone (2 cm. by 0.5 cm. by 0.5 cm.) was placed on the raw lateral cortex of the femur about 3 cm. below the head of the nail. (Fig. 5.) The periosteum had been stripped from the area. These pieces of bone were held in

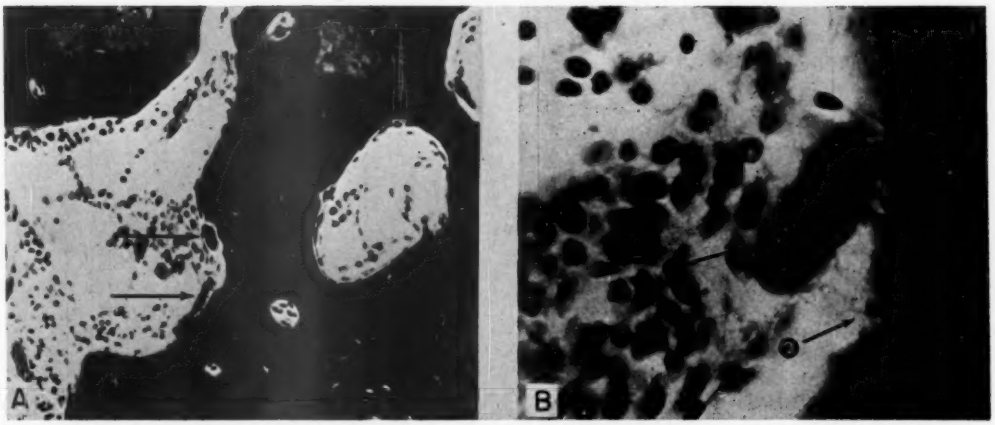


FIG. 4. Heterologous anorganic bone graft, cow to dog, at six weeks. Section was decalcified, embedded in celloidin, and stained with hematoxylin and eosin. A, medium power view shows several typically large, multinucleated osteoclasts near edge of host callus which has developed in graft site (arrows). Note erosion pits along edge of bone trabecula. B, high power view shows oval osteoclast possessing nine nuclei near edge of reactive new bone (1). It appears to be in the process of engulfing two osteocytes along the edge of its striated border. An osteocyte is about to be shed on lower right (2).

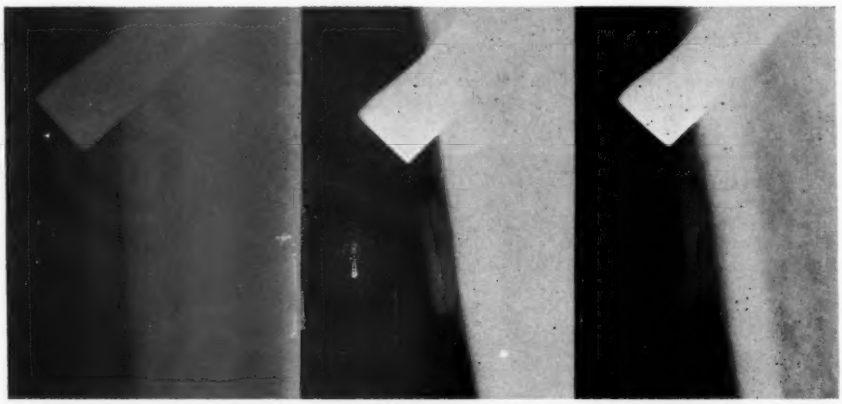


FIG. 5. Patient G. S. A block of dense cortical bovine anorganic bone was placed on raw lateral cortex of femur. *Left*, postoperatively. *Center*, at two months. *Right*, at five months.

position by several sutures through the vastus lateralis. In four patients, radiographic evidence of reactive new bone which united the implant to the femur could be seen within the first two months. Remodeling, as indicated by a change in opacity and softening of the bone edges, could be demonstrated as early as five months postoperatively. In one case, the anorganic block became displaced in the soft tissue, and five months after implantation no evidence of remodeling could be demonstrated.

Anorganic bone was used as an implant or filling material in bone defects in eight patients. The defects ranged in size from about 0.5 cm. in diameter (Fig. 6) to 12 cm. by 4 cm. (Fig. 7.) In seven cases, the bone was well tolerated by the host and rapidly incorporated in reparative callus two months postoperatively. (Fig. 8.) Radiologic studies of these cases revealed portions of the implants to be present in the defects after periods up to eighteen months. (Fig. 9.) In a comparable group of cases treated with cathode-radiated homogenous bone from a bone bank, restitution of the medullary trabecular pattern and complete removal of residual graft material was found after six to

FIG. 6. Patient T. L., a twenty-eight year old man. Enchondroma of base of proximal fifth phalanx, curetted and packed with bovine anorganic bone. *Left*, preoperatively. *Center*, postoperatively. Fragments have been carried into soft tissue by hematoma. *Right*, one year subsequent to surgery. Bone in soft tissue has been largely absorbed, implanted bone has been incorporated in reparative callus, and remodeling has occurred.

FIG. 7. Patient D. K., a fifteen year old boy. Bone cyst of upper extremity of right humerus, curetted and packed with 250 cc. volume of dense anorganic cortical bone chips. *Left*, preoperatively. *Center*, postoperatively. *Right*, six months postoperatively.

eight months [3]. In one case in which anorganic bone was used, an inflammatory response developed after two weeks. This resulted in sequestration and expulsion of the implants. No evidence of primary contamination was found, but the cancellous bone had been pulverized and was carried in powder form into the fascial and subcutaneous regions by hematomas.

Anorganic bone was used in association with fractures, and in reconstructive procedures

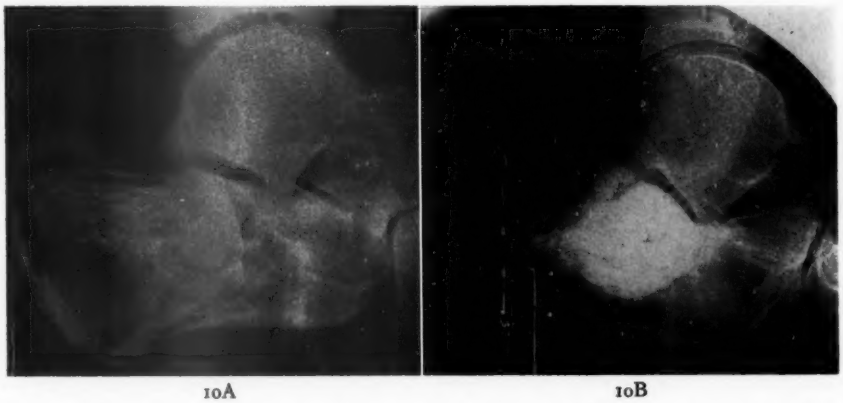
FIG. 8. Patient R. K. B., a five year old white boy. Bone cyst of proximal end of right femur curetted and packed with bovine anorganic bone fragments. Two months postoperatively bone is incorporated in reactive callus of host.

FIG. 9. Patient R. K. B. Eighteen months postoperatively portions of the anorganic bone implants are still present.

such as cranioplasty, wrist fusion, clavicular resection, etc., in fifteen patients. In each instance the patient returned to normal function and activity after the surgical procedure. Figures 10A and B illustrate such a case. Radiologic evidence of incorporation and solid union of the grafts with host callus was noted at an early stage in each case.

In thirty Hibbs' type spinal fusions, varying amounts of anorganic bone were used along with either fresh autogenous bone or homogenous merthiolate bone from the bone bank in order to assess the host's initial acceptance of this material. Patients were followed up from periods of six to twenty-four months with clinical examination and biplaner stress roentgenograms. Only one case of pseudarthrosis was identified with these technics.

Three hundred cranial burr hole plugs, fashioned of anorganic bone, were used subsequent to neurosurgical procedures in ninety patients. In these studies, made at the Neurological Institute, Columbia-Presbyterian Medical Center, by Rosomoff and Pool, anorganic bone plugs were used in lieu of Vitallium® discs to reconstruct burr hole defects in the skull. The burr hole plugs were accepted in these cases without gross evidence of untoward reaction. A particular advantage in the use of



10A 10B

FIG. 10. Patient S. M., a forty-six year old man. Roentgenograms illustrate use of anorganic bone in reconstruction of comminuted fracture of os calcis. A, subsequent to injury. B, twenty months after operation (note restoration of normal tuber joint angle).

radiolucent bone plugs instead of metallic plates is that readable postoperative roentgenograms of the entire skull may be taken. In Table 1, a line separates the records of those patients in whom spinal fusions, cranioplasties and cranial burr holes were used to evaluate anorganic bone. This has been done to indicate that a comprehensive evaluation cannot be made in these cases. It can be concluded only that in these groups no clinical evidence of early or late inflammatory response to the implantation of anorganic bone could be detected.

COMMENTS

To the plastic surgeon, the word "take" connotes living and persisting (homovital graft) [25]. Barth [2] concluded from his histologic studies (1893 and 1895) that "all elements of both autografts and homografts of bone die and are replaced by host tissue." With the exception of the meticulously handled cancellous autograft, this concept is generally considered to hold true today. Hyatt [17] states that to the orthopedic surgeons the word "take" implies biologic acceptance and, finally, replacement by similar tissue from the host rather than one of viability (homostatic graft) [25].

The early experiments of Axhausen [1], Marchand [22], Barth [2], Phemister [26] and numerous other investigators since [7] have demonstrated that dead bone may be absorbed and replaced (creeping substitution) by living bone from the host when implanted into living bone. Ray and Holloway [27] concluded that "the best substitute for fresh autogenous bone (mechanical factors not considered) is the organic matrix of bone devoid of its inorganic salt." Losee and Hurley [20], on the other hand, concluded that the inorganic (crystalline and non-crystalline) latticework of bone "might function as a replacement material in osseous defects." With the removal of the organic constituents, bone attains an enormously increased free mineral surface area which is immediately available without the need for biologic debridement (100 sq. m. per gm.) [13]. It was believed that the "rate of healing of a bone graft might not depend on its content of viable cells, but rather on the ease with which the osteogenetic tissues of the host could penetrate and organize it." It is well known, for example, that drastic treatment of donor bone, such as boiling, probably denatures the protein which makes it less acceptable as a graft. However, the primary motivation for the initial study of anorganic bone was based on the hypothesis that the biologic failure of bone grafts is due to an unfavorable response of the host to the various organic constituents of the graft.

Depending on the method used for preservation or sterilization, the organic components remain either in a nearly native state or in varying degrees of degeneration. Since it was not known which of these components or combination of components were responsible for rejection of the graft, we decided to start with a bone that would be essentially free of its organic constituents.

The concept of removing the organic matrix of bone is not a new one. In 1934 Orell [24] published the results of experiments in which ox bone was freed of periosteum, endosteum and all the other elements of the connective tissue series by a process of maceration. He called the resulting product "os purum." The preparation of this material was described as a complicated, wearisome process to be carried out only by an especially qualified chemist. Maatz and Bauermeister [23] have recently reported the experimental and clinical use of macerated bone, which was also produced by a complex and expensive procedure.

The rapid increase of recent literature on the subject of bone transplantation and the appearance of multitudinous conflicting reports have led to considerable confusion regarding the entire matter. We have found the classification shown in Figure 11, suggested by Captain G. W. Hyatt and modified by Dr. C. Andrew L. Bassett of our institution, to be of value. This classification includes all technics of obtaining and preserving bone for surgical procedures in common use. It rates the bone employed as a first, second, third or fourth grade graft according to its "osteogenic potential." The osteogenic potential of a graft may be defined as its ability to produce new bone either *per primum* or by secondary induction, and its capacity to support, conduct and be removed by the total osteogenic response of the host. According to this classification, a first grade graft, if properly handled, would contain a significant number of viable cells, existing largely in the marrow-vascular space. These cells contribute to the host's response in the formation of new osseous matrix which facilitates rapid incorporation and

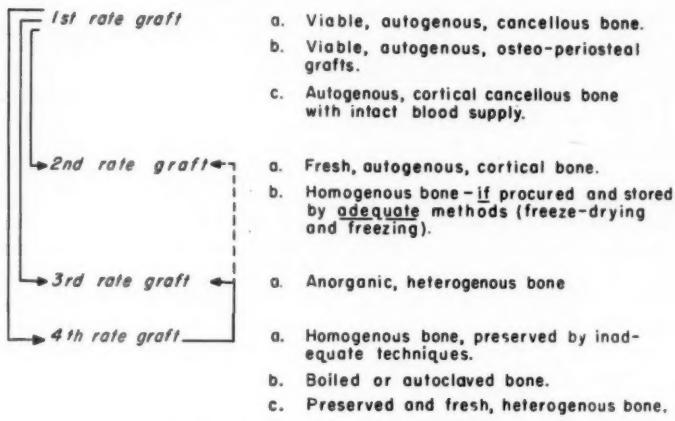

1st rate graft
a. Viable, autogenous, cancellous bone.
b. Viable, autogenous, osteo-periosteal grafts.
c. Autogenous, cortical cancellous bone with intact blood supply.
2nd rate graft
a. Fresh, autogenous, cortical bone.
b. Homogenous bone – if procured and stored by adequate methods (freeze-drying and freezing).
3rd rate graft
a. Anorganic, heterogenous bone
4th rate graft
a. Homogenous bone, preserved by inadequate techniques.
b. Boiled or autoclaved bone.
c. Preserved and fresh, heterogenous bone.

FIG. 11. Osteogenic potential of bone grafts.

remodeling. A second grade graft consists of bone matrix compatible with that of the host, but it contains no viable cells. This type of transplant is acceptable to the host, and functions as a "homostatic graft" which allows full expression of the host's osteogenic potential. In a second grade graft, osteoconduction is facilitated and remodeling occurs at a rate approximating that of the fresh autograft. A third grade graft is acceptable to the host and it is rapidly invaded by the osteogenic tissue of the host, but it has a slower rate of replacement than the autograft or homograft. Some inhibition of the total osteogenic potential of the host must occur as long as space is occupied by unresorbed bone. A fourth grade graft, by this definition, may contain substances which are toxic to the host cells. The degree of reaction to the use of this graft may adversely affect the host's osteogenic response through the intensity of the inflammation incited by noxious materials in the graft.

As is shown in Figure 11, a first grade graft may be converted to a second grade graft by any lapse in surgical procedure which kills cells. This could occur by too rapid evaporation (drying) or by exposure of the graft to normal saline solution, and to the battery of chemicals usually found on the operating table, i.e., sponge sizing, phenol, antibiotic solutions [3]. If a fresh autograft were accidently dropped on the floor, it could be converted to a second grade graft by freezing or freeze-drying, a third grade graft by extraction with ethylenediamine, or a fourth grade graft by autoclaving or boiling. In Figure 11, a solid line passes from the fourth grade level to the third grade level. This indicates the result of these particular studies, i.e., the conversion of a fourth grade graft to a third grade graft. A dotted line passes from the third grade level to the second grade level. This indicates the direction of future research, which in the case of anorganic bone should be aimed at restoring tensile strength and facilitating a more rapid replacement by the bone of the host.

Anorganic bone, when properly used, is well tolerated by the host and rapidly incorporated in reactive formation of new bone. However, resorption seems to occur at a much slower rate than in certain other bone grafts. For example, anorganic bone is still observed to be present two years subsequent to implantation in a fracture of the os calcis. (Fig. 10B.) This fact has also been demonstrated by the studies in animals of Sissons and Chalmers [30], who demonstrated that bone treated with ethylenediamine is indeed revascularized at a rate comparable to that observed with the autograft, but that remodeling is significantly delayed. The explanation for this is not clear. However, Holmstrand [14], by applying technics of microradiography and microradiographic defraction, has observed "definitely slower resorption rates in os purum glycero-lashed bone and cooked bone implants." Fresh and frozen transplants were resorbed equally well according to his studies. Holmstrand concluded that slower resorption rates could probably be explained by the increase in

crystal size which occurs when bone mineral is heated.

A second point of interest should be mentioned. Losee and Hurley [20] reported that in experimental studies "osteoclasts appeared in the body of an 'anorganic implant' to a lesser degree than in the whole bone transplant." A recent review of these histologic sections has indicated that osteoclasts are found only in the regions of reactive bone in the host, and in the more central layers of perivascular new bone which appears to be undergoing a second phase or remodeling. Osteoclasts have not been found adjacent to the surface of the anorganic implants. This observation may be of interest to those who maintain that the primary function of an osteoclast is the removal of non-vital organic matrix [10,11].

Anorganic bone, especially of the cancellous type, has been observed to produce an intense foreign body reaction when impacted into the tooth socket of a dog [22]. On microscopic examination, small sharp spikes of bony trabecula appeared by mechanical irritation alone to have resulted in the accumulation of numerous multinucleated giant cells. In this series, one patient developed a similar response to a lesser degree when cancellous anorganic bovine bone was ground into the defect with a steel surgical instrument. Therefore, particle size appears to be an important consideration. This danger would always be inherent if anorganic bone were used clinically for the purposes of fixation where it would be subject to fragmentation.

To date, it is too early to draw definite conclusions from experience with anorganic bone. Studies of the long term fate of this material, when transplanted, are definitely in order and are now in progress.

SUMMARY

This report presents a preliminary account of experience with anorganic bone in surgical procedures on 149 patients whose progress was followed up from five months to two years. When properly handled, anorganic bone has been well tolerated by the host and rapidly incorporated in reparative callus at an early stage. With one exception, no untoward responses occurred in this series of cases. If the material is too fine, a non-specific inflammatory response may be anticipated. In the presence of infection, necrosis of tissue or avascularity, anorganic bone is poorly tolerated, and becomes extruded or walled-off as would other alloplastic materials.

Studies of the radiologic evolution of anorganic bone grafts, compared with homogenous grafts from bone banks, has revealed a slower rate of removal of the anorganic bone implant.

Grafting with anorganic bone should not be used when fixation is required, because of the extreme fragility of the material. It serves best as an implant or filling material in bone defects when it acts to prevent the invasion of fibrous connective tissue and to supply an absorbable trellis through which new bone from the host may develop. As a basic criterion for clinical use, anorganic bone should be employed only in osseous defects which would reconstitute themselves, provided fibrous tissue were prevented from entering the empty space, and then only in situations in which first and third grade grafts are not available.

These preliminary findings indicate that further experimental and clinical evaluation must be undertaken before this material can be recommended for general use. The real significance of this study may be in its application to our understanding of the basic nature of bone as a tissue.

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Surgical Considerations of Non-penetrating Abdominal Injuries

AN ANALYSIS OF 200 CASES

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ACCORDING to the most recent available National Safety Council estimates, there were 95,000 accidental deaths in the United States in 1956 [4]. Of these deaths, 40,000 were from motor vehicle accidents. The increasing incidence of death from this cause is evident by the increase of motor vehicle accidental deaths from 34 per cent of all accidental deaths in 1946 to 42 per cent in 1956. Although the automotive industry has made distinct advances in the development of protective safety devices, there seems little reason to anticipate a significant decrease in the number of motor vehicle accidents or deaths, particularly in the presence of current demand for higher speed and greater horsepower both on the ground and in the air. The surgical significance of these injuries is obviously increasing. For this reason, the experience of a large accident room service was reviewed, and this report is concerned with one phase of the problem, namely, non-penetrating abdominal injuries.

CLINICAL MATERIAL

The clinical records of the Jefferson Davis Hospital and the autopsy records of the county pathologist (medicolegal) were reviewed, and cases of non-penetrating intra-abdominal injury proved by operation and autopsy were selected for study. For statistical purposes and to gain insight into the total problem, the 100 most recent consecutive cases of non-penetrating abdominal injury were selected from each source, making a total of 200 cases; 100 patients were alive on admission to the hospital and 100 were dead on arrival. The serious and lethal nature of these injuries is indicated by the difference in the length of the periods during which these cases were obtained. For example, only 100 patients arrived alive at the hospital during the ten and a half-year period from January 1948 to July 1958, whereas 100 patients were dead on arrival during the two year and seven month-period from January 1954 to August 1957.

AGE AND SEX INCIDENCE

The ages of these patients ranged from five months to eighty-seven years with the highest incidence (55 per cent) in persons between the ages of twenty-one and fifty years. Of the thirty-four patients less than ten or more than seventy years of age, eighteen (53 per cent) were pedestrians in auto-pedestrian accidents. Poor judgment and carelessness on the part of the children and certain physical defects in the elderly, such as arthritis, deafness, mental obtundity and poor vision, apparently were important factors in this group. There were 146 males (73 per cent) and fifty-four females (27 per cent) in this series of cases.

METHOD OF INJURY

Injury resulted from motor vehicle accidents in 167 cases. (Table 1.) Injury in thirteen cases was produced by blunt weapons including kicks or blows with fists, clubs and other instruments. Injury resulted from falls in ten cases and in the remaining ten from miscellaneous causes including train accidents in five and crushing by a heavy weight in four. In one case, a child was injured by running into a gate post while playing.

TABLE I
TYPE OF TRAUMA PRODUCING BLUNT ABDOMINAL INJURY IN 200 PATIENTS

Type	No. of Cases	Per cent
Motor vehicle	167	83.5
Passenger	110	66
Pedestrian	57	34
Blunt weapon	13	6.5
Fall	10	5.0
Miscellaneous	10	5.0
Total	200	100

The condition of the patient on admission to the hospital varied with the type of injury. The patients with localized abdominal injury resulting from kicks and blows survived to reach the hospital alive, whereas the majority of the patients dead on arrival had been involved in train and automobile accidents resulting in more diffuse injury.

ABDOMINAL ORGANS INJURED

All intra-abdominal organs were involved in this series of cases. (Table II.) Multiple abdominal injury was frequent, occurring in sixty cases (30 per cent), and the condition of the patient on admission varied with this factor. Thus, in this series of cases, forty (40 per cent) of those who died before admission had multiple injury whereas multiple intra-abdominal injury was present in only twenty (20 per cent) of the patients alive at the time of admission. The liver was the most common organ injured and also was the most fatal abdominal injury, with the highest incidence of death occurring in this group of patients. Death occurred before admission to the hospital from massive hemorrhage in seventy-four of the patients with this injury, and of thirty-one patients with liver injury who were alive on admission, eighteen (58 per cent) died in the hospital. Thus liver injury was a factor in the death of ninety-two patients, or 70 per cent of all the deaths occurring in the series. The critical nature of liver injury was related to injury to other abdominal organs; for example, death occurred in thirty-five of the thirty-six patients who had injuries to both the liver and spleen. Splenic injury was the second most common abdominal injury in the entire series, and it was the most common injury in the patients alive on admission to the hospital. Although splenic injury was associated with a high incidence of death before and after admission to the hospital, this injury was

TABLE II
ABDOMINAL ORGANS INJURED IN 200 PATIENTS WITH BLUNT ABDOMINAL TRAUMA

Organ	Entire Series		Dead on Arrival		Living on Arrival		Survival (Group Admitted Alive)	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Liver	105	52.5	74	74	31	31	13	42
Spleen	93	46.5	42	42	51	51	35	69
Small bowel	18	9	5	5	13	13	10	77
Mesentery	16	8	2	2	14	14	10	71
Diaphragm	16	8	8	8	8	8	5	62
Colon	10	5	5	5	5	5	3	60
Kidney	9	4.5	5	5	4	4	3	75
Bladder	8	4	4	4	4	4	3	75
Abdominal wall	4	2	0	0	4	4	4	100
Stomach	2	1	1	1	1	1	0	0
Pancreas	2	1	0	0	2	2	1	50
Omentum	2	1	0	0	2	2	2	100
Renal artery	2	1	1	1	1	1	0	0
Inferior vena cava	2	1	1	1	1	1	0	0
Gallbladder	1	0.5	0	0	1	1	1	100
Torn adhesion	1	0.5	0	0	1	1	1	100

TABLE III

ASSOCIATED INJURY IN 200 PATIENTS WITH NON-PENETRATING ABDOMINAL INJURY

Injury	Entire Series		Dead on Arrival		Living on Arrival		Survival (Group Admitted Alive)	
	No.	Per cent	No.	Per cent	No.	Per cent	No.	Per cent
Rib fractures	108	54	71	71	37	37	21	57
Long bone fractures	74	37	45	45	29	29	17	59
Craniocerebral	62	31	44	44	18	18	5	28
Pulmonary	62	31	50	50	12	12	4	33
Pelvic fracture	40	20	21	21	19	19	13	68
Spinal fracture	29	14.5	25	25	4	4	2	50
Heart and great vessels	19	9.5	19	19	0	0	0	0
Urethra	4	2	0	0	4	4	4	100
None	33	16.5	3	3	30	30	28	93

responsible for fewer fatalities than liver injury. Organs less frequently injured were the small intestine, mesentery, diaphragm, colon, kidneys, bladder, pancreas and inferior vena cava. Injuries to the diaphragm, kidney and bladder were associated with a 50 per cent incidence of death before admission to the hospital since these injuries were usually due to diffuse trauma frequently involving the entire body. The majority of patients with injury to the mesentery and small intestine survived since these injuries were not usually associated with massive hemorrhage.

ASSOCIATED EXTRA-ABDOMINAL INJURIES

The mechanism of injury in the majority of these cases resulted in a high incidence of associated extra-abdominal injury, frequently of the entire body. (Table III.) The condition of the patient on admission to the hospital and his ultimate survival were dependent upon the location and extent of the associated injuries. Severe associated extra-abdominal injury was present in ninety-seven (97 per cent) of the patients who died before admission to the hospital, whereas death occurred before admission in only three patients with injury limited to the abdomen. Associated injuries to vital structures such as the heart, lungs, great vessels, head and spine were the most critical. All patients with injury to the heart and great vessels were dead on arrival at the hospital. Of the 100 patients alive on admission to the hospital, seventy had severe associated injuries, masking the abdominal injury in three patients and causing death in seventeen patients immediately upon admission. Although severe associated injuries to all organs except the heart and great vessels were present in fifty (60 per cent) of the eighty patients surviving to be treated, effective therapy resulting in survival was possible in thirty-nine (78 per cent) of the patients with associated injuries.

CONDITION OF SURVIVORS ON ADMISSION

The majority of patients alive on admission to the hospital were in critical condition. As previously indicated, seventy of the 100 patients had serious injuries other than those of the abdomen. (Table III.) Stupor and coma were frequently present in those patients with injury to the head, and intrathoracic injury was associated with severe disturbances of respiration. Hypotension or shock was present in the majority of cases. The systolic blood pressure was below 90 mm. Hg in fifty-seven patients and less than 60 mm. Hg in twenty-seven patients. Survival of the patient was related to the extent of blood loss and varied with the level of blood pressure on admission. For example, forty patients (93 per cent) whose systolic blood pressure was above 90 mm. Hg survived injury and were discharged from the hospital, in contrast to only twenty-seven (47 per cent) of the fifty-seven patients with pressures below 90 mm. Hg. The results of hemoglobin and hematocrit determinations in these patients at the time of admission were essentially normal. The white blood count, on the other hand, was usually elevated, being

above 10,000 per cu. mm. in 75 per cent of the cases.

Abdominal injury was evident by local signs of injury on the abdominal or chest wall, tenderness, absent muscle spasm or hypoactive bowel sounds, and abdominal distention. In the unconscious or moribund patients, intra-abdominal injury was suspected from signs of continued hemorrhage not evident externally, in the site of fracture or in the chest. Diagnostic paracentesis was used in the study of ten patients with clinical evidence of intra-abdominal injury later substantiated by exploration. The results were positive in six patients, three with splenic rupture, two with rupture of both the liver and spleen, and one with rupture of the small bowel. Negative results were obtained in four patients, one with lacerations of the liver, one with rupture of both the liver and spleen, one with rupture of the diaphragm, mesentery, kidney and bladder, and one who had a large retroperitoneal hematoma. Because of the high incidence (40 per cent) of false negative results and the greater reliability of the clinical findings in the determination of abdominal injury, abdominal paracentesis was considered inadequate for diagnostic purposes except when the patient was moribund from multiple injury.

Roentgenographic examination, employing injections of contrast medium into the veins or bladder, confirmed the presence of injury to the urinary tract in most cases, and plain roentgenograms were particularly helpful in the appraisal of the nature and extent of associated injuries to the chest (including diaphragm), bones and head. Although the demonstration of such skeletal injuries as pelvic and rib fractures suggested the possibility of certain intra-abdominal injuries to such organs as the urethra, bladder, spleen, liver and diaphragm, roentgenographic examination was of little value in the confirmation of intra-abdominal injuries other than those of the urinary tract previously mentioned. Roentgenograms of the abdomen were made in the supine and upright or lateral decubitus positions of fifteen patients with perforations of the gastrointestinal tract. Free peritoneal air was demonstrated in only two of these patients, and in the others the findings were normal. Splenic rupture was evident roentgenographically in only three of the patients examined. Injuries to the liver, mesentery, vena cava, pancreas and omentum were not evident by roentgenographic examination. Consequent to these limitations, roentgenography was of no real practical assistance in the diagnosis and management of intra-abdominal injury except in patients with injury to the urinary tract. Moreover, the time spent obtaining abdominal roentgenograms was frequently of greater benefit to the patient when devoted to the institution of therapy including abdominal exploration. Of particular interest in this regard is the fact that death did not occur in any patient subjected to laparotomy in whom no intra-abdominal injury was found. On the other hand, death occurred from intra-abdominal hemorrhage in three patients in whom exploration was not performed because of associated craniocerebral injuries which masked the abdominal injury.

TREATMENT

Treatment in the majority of these cases consisted of the type employed in the management of patients with massive trauma and multiple injuries. Priority given to the treatment of a specific injury was dependent upon the critical nature of the disturbances produced by the injury. Although therapy was usually simultaneously directed toward more than one disturbance, the order of priority in most cases was restoration and maintenance of airway, restoration of normal pulmonary function, control of hemorrhage, restoration of blood loss, stabilization of fractures, and closure of defects in the gastrointestinal and urinary systems. Airway obstruction resulted from tracheal injury, aspirated blood, mandibulofacial fractures and various cervical injuries. A normal airway was restored in these patients by tracheotomy and endotracheal aspiration either through a tracheotomy tube or by bronchoscopy. Endotracheal tubes were inserted in moribund patients, and after restoration of normal oxygenation, airway was maintained by tracheostomy performed with the endotracheal tube in place.

Thoracic injuries resulting from blunt non-penetrating trauma were frequently bilateral and associated with multiple rib fractures, pneumothorax, hemothorax, intrapulmonary hemorrhage and paradoxic motion of the chest wall. Pneumothorax, either bilateral or under tension, and paradoxic movement of the chest wall were associated with severe respiratory insufficiency. Normal ventilatory function was restored by continuous aspiration of the pleural

cavity employing intercostal tube drainage and stabilization of the chest wall with an external bandage. Tracheostomy was performed in most patients with diffuse thoracic injury to reduce the dead air space, lower airway resistance and aspirate the tracheobronchial tree. A short "cuffed" endotracheal tube was employed as the tracheostomy tube in the more recent cases, and with the balloon inflated, normal ventilation was controlled by employing one of the machines designed for this purpose.

Immediately upon admission of the patient, blood volume replacement was begun by one member of the surgical team as other members restored normal cardiorespiratory function. Normal saline solution containing Neo-synephrine,® dextran and unmatched low titer O-negative blood was given intravenously through large caliber needles or cannuli inserted surgically until properly matched whole blood was available. Considering the fact that hemorrhage in most cases was continuous and its control dependent upon abdominal operation, the objective in blood volume replacement was to keep up with blood loss from continued hemorrhage and restore sufficient volume to provide an effective circulation. Blood volume replacement using whole blood sufficient to maintain systolic blood pressure between 90 and 100 mm. Hg was considered adequate preparation for definitive operation which would control hemorrhage and permit restoration of normal blood volume. Complete restoration and maintenance of normal blood volume as a prerequisite of operation would have been impossible in many cases, and had time and effort been expended toward this objective, death would have occurred from uncontrolled hemorrhage.

After restoring normal airway and cardiorespiratory function and starting blood volume replacement, long bone fractures were immobilized by temporary external splints to prevent extension of injury until more definitive orthopedic therapy could be instituted. Large caliber nasogastric tubes were inserted to empty the stomach, and small doses of sedatives and opiates were given as anesthetic premedication. Employing endotracheal general anesthesia, the abdomen was entered routinely through a long midline incision because it afforded good exposure in most cases and could be performed quickly. For additional exposure in some cases of liver injury, the midline incision was converted into a right thoracoabdominal incision by entering the eighth intercostal space. As the abdomen was opened, bleeding frequently increased and blood pressure dropped. Attempts were made to control hemorrhage quickly, and if this proved impossible, the aorta was temporarily clamped in the crus of the diaphragm until the hemorrhage had been controlled. This maneuver has been found to be safe for periods up to thirty minutes in normotensive patients; however, in these patients with hypotension the aortic clamp was temporarily released every fifteen minutes when the required period of occlusion was longer. This maneuver did not affect venous bleeding. Massive arterial blood loss was controlled distal to the occluded aorta, and by increasing peripheral resistance, blood pressure was more easily maintained.

Treatment of specific intra-abdominal injuries requires little discussion. Splenic injury was treated by splenectomy. Small perforations of the stomach and small intestine were treated by simple closure. Larger perforations associated with local crushing, and injuries resulting from lacerations of the mesentery that extended into the intestine were treated by resection and end-to-end anastomosis. Rupture of the bladder and urethra was treated by closure, urethral catheterization and suprapubic cystostomy. Renal injuries were usually repaired by suture; however, nephrectomy was performed when the hilar structures, including arteries, veins and renal pelvis, were irreparably damaged. Lacerations of the diaphragm were simply sutured from the abdomen. Liver injury was the most difficult abdominal injury requiring treatment in this series of cases. In most patients these wounds were multiple in nature, frequently extending into the hilum of the liver, and were occasionally associated with avulsion from the vena cava. All known methods of repair were required in the management of this injury, including suture with use of large caliber suture material on long needles, resection of devitalized hepatic segments, and packing with Gelfoam® sponge and Oxycel® gauze. In rare instances liver wounds required packing with uterine packs to control hemorrhage. In the latter cases, the end of the gauze was brought out through a separate incision as a drain and removed later. Wounds of the pancreas that severely injured the body were treated by removing the segment distal to the injury along

with the spleen, suture ligation of the proximal duct, and suture of the pancreatic stump. All wounds of the pancreas, liver and urinary tract were drained through separate incisions.

Long bone fractures were usually treated after the abdomen was closed, provided that the fracture therapy was simple and the patient's general condition permitted a short period of additional anesthesia. Compound fractures were debrided in some cases, but more complicated and extensive orthopedic procedures were deferred until the patient's general condition had improved. The treatment of injury to the head was non-operative in most instances. Treatment of those conditions requiring early operation, such as subdural and epidural hematoma and lacerations of the scalp, was relatively simple and could be instituted at the end of the abdominal operation. The treatment of depressed skull fractures and other cerebral injuries was usually deferred.

RESULTS

Death occurred in thirty-three of the 100 patients who were alive on admission to the hospital. Injury had been produced by motor vehicle accidents in thirty-two of these patients, resulting in multiple intra-abdominal and extra-abdominal injury in thirty-one patients. Therapy was impossible in seventeen patients because death occurred almost immediately upon admission to the hospital from splenic and/or liver hemorrhage associated in most cases with severe disturbances resulting from injuries to the head, chest and long bones. Intra-abdominal injury was not suspected at the time of admission in three patients, representing the only errors in diagnosis; these patients subsequently died of intra-abdominal hemorrhage during neurosurgical operations. In the remaining eighty patients the injuries were correctly appraised, and their condition on admission permitted application of the previously described principles of therapy including laparotomy. Treatment was successful, and sixty-seven of these patients (84 per cent) survived and were discharged from the hospital. Survival in these cases was dependent upon the presence of associated injuries; for example, thirty-nine (78 per cent) of the fifty living patients with associated injuries and twenty-eight (93 per cent) of the thirty living patients with injury limited to the abdomen survived. Death occurred in thirteen patients who were submitted to operation, seven from craniocerebral injuries, two from multiple long bone fractures and hemorrhage, and one each from liver fracture, renal failure, peritonitis and aspiration pneumonitis.

COMMENTS

This study of a large series of patients with non-penetrating abdominal injury sufficient to require operation or cause death emphasizes the problems imposed by blunt trauma in general. Although the prognosis is reasonably good in patients with selective blunt injuries localized to the abdomen, the majority unfortunately have multiple injuries, each one of which may produce serious disturbances in function and compound the problems of therapy or rapidly lead to death. In this series of 200 cases only thirty-three patients (16.5 per cent) had injury localized to the abdomen. Despite injury associated with massive hemorrhage, thirty of these patients were alive, 93 per cent of whom were admitted for successful treatment. Multiple injury occurred in 167 patients (83.5 per cent), causing death in ninety-seven patients before admission to the hospital and in seventeen patients before therapy could be employed. Of the fifty patients with multiple injury submitted to the full therapeutic facilities of the hospital, 78 per cent survived. This survival rate is indeed low, and in the absence of a comparable series of cases, an accurate comparison of survival rates is impossible. There are several studies available in which all patients with blunt trauma admitted to a hospital were included [2,3]. The survival rates of the small number of comparable cases in these studies were considerably less than that in our series of cases. This does not reflect the advantages to be obtained from experience as much as it does the over-all problem of a high mortality rate from diffuse blunt injuries.

The patients in this series were treated by a competent staff experienced in the daily management of trauma. A review of the deaths that occurred in the hospital revealed a limited area in which treatment could have been improved. Abdominal injury was not suspected in three patients admitted with craniocerebral injuries. Although these patients were mentally incompetent, the abdominal examination was reasonably normal and there were no signs of hemorrhage or excessive blood loss. For these reasons, neurosurgical procedures were per-

formed soon after admission and the patients died from intra-abdominal hemorrhage during operation. Although the craniocerebral injuries may have eventually prevented survival, death from hemorrhage could have been prevented by abdominal operation; this emphasizes the advantages in a longer period of abdominal observation before embarking upon procedures, particularly under general anesthesia, which are not life-saving in nature. This principle would, of course, apply only in patients who did not have evidence of continuing blood loss. In the latter group of patients, early abdominal operation to control hemorrhage is essential, and occasional negative findings are justified on the basis that death rarely occurs in patients in whom abdominal injury is not confirmed by operation.

This study emphasizes the limitations of roentgenographic examination in the diagnosis and treatment of abdominal injury; consequently, valuable time should not be expended in the fruitless search for injury by this method in the presence of clinical signs of abdominal injury. Evidence of continued hemorrhage and the suspicion of abdominal injury require immediate action directed toward the abdomen in the operating room and not in the radiology suite. The treatment of fractures is secondary to the control of hemorrhage, and in the presence of continuing hemorrhage from abdominal injury the study of fractures by radiographic methods should be deferred uutil after abdominal operation. This was well demonstrated in two patients in this series of cases who died of intra-abdominal hemorrhage while awaiting radiologic examination of fractures.

Since the majority of deaths from blunt trauma involving the abdomen occur before admission to the hospital, and since a critical analysis of hospital deaths reveals only a small chance of increasing survival by improved care, the real possibility of decreasing death from blunt injury lies in the prevention of automobile accidents or minimizing the extent of injury. Although this approach lies within legal and social fields, certain observations related to the cause and extent of injury are apparent in the medical management of these cases. First, the majority of accidents in this series of cases occurred as a direct violation of traffic laws. A large percentage of the patients admitted with blunt injury were intoxicated, evident by clinical examination in the survivors and by high cerebrospinal fluid alcohol levels in those patients who were dead when admitted to the hospital. Speeding and reckless driving were among other law violations charged in these cases. Suggestions for the prevention of driving while under the influence of alcohol as well as for the prevention of other traffic violations are outside the scope of this study; however, it is obvious that successful efforts in this direction would result in the saving of more lives than the best medical care.

The second possibility of increasing survival from blunt trauma lies in the reduction of injury. This aspect of the problem has been extensively studied by Braunstein, Moore and Wade [1], who have shown that recent engineering changes have significantly reduced the injury potential of certain factors related to the interior design of automobiles. For example, improvements in door locks or fasteners have produced a 50 per cent reduction in the incidence of passenger ejection on impact; prior to 1956 this was one of the most common mechanisms of fatal injury. The use of seat belts similarly reduced the incidence of fatal injury. The results of these engineering improvements are extremely encouraging and indicate that more emphasis should be placed on the safety factor in the design of future automobiles.

SUMMARY

The number of motor vehicle accidents and deaths from this cause are steadily increasing each year. The surgical significance of these injuries is obviously increasing also, and for this reason the experience of a large accident room service with one phase of the problem, namely, non-penetrating abdominal injury, was reviewed. This study includes 200 consecutive cases, 100 patients dead on arrival and 100 patients who were alive at the time of admission. The majority of patients (83.5 per cent) were injured in motor vehicle accidents. The remaining patients were injured by blows, train accidents, falls and crushing accidents. Serious extra-abdominal injuries were present in 167 patients. The injury was limited to the abdomen in only thirty-three patients. Multiple diffuse injury to the body was present in ninety-seven of the patients who were dead on arrival, and similar injuries were present in seventy of the patients admitted alive.

Treatment was possible in eighty patients.

The injury was localized to the abdomen in thirty cases, and in the remaining cases the abdominal injury was associated with injuries to the cerebrum, spine, thorax, long bones and pelvis. Although all abdominal organs were involved in this group of cases, the liver and spleen were involved in sixty patients. Therapy consisted of that employed for massive trauma. Priority of treatment depended upon the vital function disturbed. Cardiorespiratory function was restored, and then hemorrhage was controlled by abdominal operation. The treatment of fractures and craniocerebral injuries was deferred until after abdominal operation in most cases. Of the eighty patients submitted to the full therapeutic facilities of the hospital, sixty-seven (84 per cent) recovered. Survival in this group was dependent upon the presence of associated injuries; for example, survival occurred in thirty-nine (78 per cent) of the fifty patients with associated injuries and twenty-eight (93 per cent) of the thirty with injury limited to the abdomen. Death in the treated patients was due to a severely lacerated liver in one, renal failure in one, peritonitis in one, and complications arising from extra-abdominal injuries in ten.

Treatment in these patients was administered by a competent staff experienced in the daily management of trauma, and although the survival rate in this series was greater than in similar series reported elsewhere, the mortality rate in general is extremely high for diffuse blunt injury. The fact that the majority of patients with these injuries die before admission and since a critical review of the deaths after admission reveals only a small chance of increasing survival by improved care, the greatest opportunity of saving life from blunt trauma lies in prevention. Although this lies within the legal and sociologic fields, certain observations obtained in the care of these patients indicate that better law enforcement and improved engineering of automobiles may significantly reduce both the number and severity of these injuries.

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Pseudocysts of the Pancreas

A REPORT OF SEVENTEEN CASES

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THE road toward definitive treatment of pseudocysts of the pancreas may be a long, tortuous one. Frequently, a history of many weeks of prehospitalization distress is present, in addition to a relatively long preoperative preparation period during which the patient's condition may actually become worse. In the series to be presented, the preoperative hospitalization period ranged from two to sixty-five days and averaged twenty-three days. Total hospital stay averaged 53.1 days. There is no question that a high index of suspicion leads to a more rapidly directed therapeutic approach. It is hoped that the presentation of certain observations of this group of seventeen pseudocysts of the pancreas may raise the index of suspicion. Only the three cases handled by cystogastrostomy are presented in detail. Thirteen cases are from the Philadelphia General Hospital and four are from Our Lady of Lourdes Hospital.

To clarify the subject matter under discussion, it is well to indicate the place of pseudocysts in a classification of cystic conditions of the pancreas. Judd, Mahorner and Mattson's [*14*] classification is useful:

1. Cysts resulting from defective development.
   a. Cysts in infants including fibrocystic disease.
   b. Cysts associated with polycystic disease of the kidneys.
   c. Dermoid cysts.
   d. Inclusion cysts.
2. Retention cysts.
3. Neoplastic cysts.
   a. Cystadenoma.
   b. Cystadenocarcinoma.
   c. Teratoma.
4. Parasitic cysts.
5. Pseudocysts resulting from:
   a. Trauma to the pancreas.
   b. Inflammation of the pancreas.

A pseudocyst of the pancreas may be defined as a collection of fluid in the lesser peritoneal sac enclosed by a capsule not lined by epithelium and maintaining a connection with the pancreatic duct. Pseudocysts arise by activation of the pancreatic enzymes with necrosis of pancreatic acinar tissue, rupture into and digestion of the tissues bordering the lesser sac. (Figure 1 demonstrates the four general directions taken by the enlarging pseudocysts.)

Meyer et al. [*19*] estimated that trauma was the precipitating factor in rupturing the pancreatic duct in 51.6 per cent of their thirty-one patients and claimed that only 16 per cent had pancreatitis and cholecystitis. Of the patients reported on by Judd et al. [*14*], 36 per cent had disease of the biliary tract. Pinkham [*21*] pointed out that 60 per cent of his patients had previous pancreatitis. Cattell and Warren [*6*] state that acute pancreatitis preceded 75 per cent of their cases. All but two (88 per cent) of our cases were preceded by a history compatible with pancreatitis. In only one case could trauma be brought into the picture as a reasonably etiologic adjunct. At least seven (41 per cent) admitted a heavy alcoholic intake. (Table 1 indicates the high incidence of heavy alcoholic intake in this group.)

The true incidence of this condition is questionable. At the Mayo Clinic, eighty-eight cases were found of 700,000 patients admitted,

and at the Henry Ford Hospital, twenty-one cases were noted of 650,000 patients admitted. At the Toronto General Hospital, however, the admission of five patients with the disease in one year (16,098 patients) prompted the report of Branden and Laird [3]. It is our belief that pseudocysts may be more common than generally surmised.

From the diagnostic standpoint there is little difficulty with the patient who has a history of one or more clear-cut episodes of pancreatitis followed by the appearance of mass either of the right, left or central part of the upper abdomen. In six (33 per cent) of our patients, however, no palpable mass was evident. In one other patient (Case 10) the palpable mass disappeared only to reappear weeks later. In the absence of a mass, lateral reontgenographic views of the stomach will reveal its anterior displacement.

Pain was present in all but one patient. The pain varied from a distressing sense of fullness to a constant, boring, severe upper abdominal pain with frequent reference to either side of the back. The pain, however, showed no diagnostic specificity. Attention is called to the case presented by Kelser, Roth and Bockus [15] in which no pain or palpable mass was evident but which yielded left pleural fluid containing 1,723 mg. per cent of amylase. Further investigation revealed a pseudocyst which lent itself to cystojejunostomy. Eight of our patients (44 per cent) showed some pleural effusion. No amylase determinations were performed on these effusions. One patient presented with a basal pleural reaction without a demonstrable collection of fluid.

Perhaps the relatively high incidence of gastrointestinal bleeding in conjunction with pseudocysts is not appreciated. Seven patients (38 per cent) showed either gross hematemesis or melena. Routine examinations of stool for occult blood were not performed in these patients but it is probable these would have been highly revealing. Non-anemic patients were the exception in this group. The most interesting case of gastrointestinal bleeding in the series was one in which no pain was present (Case 15) and massive tarry stools occurred intermittently over a two-year period.

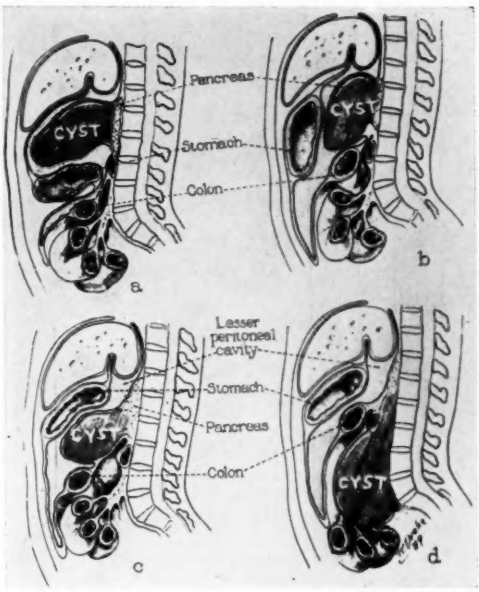


FIG. 1. Pseudocysts of the pancreas usually localize as shown in a, b and c. The location shown in d is unusual. The first three cysts are readily susceptible to cystogastrostomy. (Reprinted from: JUDD, E. S., MATTSON, H. and MAHORNER, H. R. Pancreatic cysts. Report of 47 cases. *Arch. Surg.*, 22: 838, 1931.)

CASE REPORTS

CASE 15. L. S., a fifty-eight year old white man, was admitted to Our Lady of Lourdes Hospital on July 27, 1954, with pain in the chest, left elbow, left teeth and neck. Dysphagia had been present for three years. During this time the patient was unable to eat anything but baby foods and liquids. Esophagoscopy performed three times elsewhere during this period was unrevealing. Physical examination was entirely negative for abnormalities with the exception of marked pallor. Hemoglobin was 6.6 gm. per cent; red blood cells, 2,360,000 per cu. mm.; hematocrit, 21 per cent; reticulocytes, 0.5 per cent; white blood cells, 5,350 per cu. mm.; segmented neutrophils, 71 per cent; lymphocytes, 29 per cent; platelets, 175,300 per cu. mm.; alkaline phosphatase, 5.1 units. Serum protein was 6.3 gm.; albumin, 4.7 gm.; globulin, 1.6 gm. Serum amylase was 94 Somogyi units; serum lipase, 0.1 unit. Coombs' test was negative for abnormalities. Urinalysis gave a 2 plus reaction for sugar. Stools were positive for occult blood. An upper gastrointestinal series revealed no abnormalities except for duodenal irritability. Electrocardiogram revealed myocardial damage. After receiving 2 units of blood, the patient became restless and left the hospital against advice on August 2.

He was readmitted on May 26, 1955, with pain in both forearms and weakness. The same degree of dysphagia was present. Electrocardiogram re-

TABLE 1

OUTLINE OF CLINICAL FINDINGS, OPERATIONS AND RESULTS

Case No.	Intake of Alcohol	Hospital Days	Preoperative Days	Hemoglobin (gm. %)	Diabetes	Pleural Effusion	Gastrointestinal Bleeding	Vomiting	Mass	Operation	Results
1....	Heavy	14	2	13	No	Yes	No	Yes	Yes	Incision and drainage	Fecal fistula
2....	No	35	11	14	No	Yes	Hematemesis	Yes	Yes	Incision and drainage Sphincterotomy Cholecystostomy	Good
3....	No	49	17	7.4	No	Yes	No	Yes	No	Incision and drainage	Good
4....	Heavy	112	65	10.0	No	No	Hematemesis	Yes	No	Roux's en Y	Pelvic abscess Good
5....	No	56	10	13	Yes	Yes	No	Yes	Yes	Incision and drainage	Died (cardiac cirrhosis)
6....	Moderate	35	3	6	No	Yes	Tarry stools	No	Yes	Incision and drainage	Incision and drainage again—6 mo.
7....	Heavy	47	30	10	Yes	No	Hematemesis	Yes	Yes	Incision and drainage	Moderate pain (pancreatic calculi)
8....	No	61	34	12	Yes	No	No	No	No	Partial pancreatectomy	Good
9....	No	32	12	10	No	No	No	No	No	Incision and drainage Sphincterotomy	Still undergoing drainage
10....	Heavy (first admission)	21		11.6	No	Atelectasis		Yes	Disappeared		
	Second admission	33	17	9.7	No		No	Yes	Yes	Cystogastrostomy	Good
11....	Moderate	46	33	11	No	Yes	Hematemesis	Yes	No	Excision of fistula Sphincterotomy	Good
12....	Unknown	56	12	11.5	No	No	Hematemesis	Yes	Yes	Resection of cyst. Resection of tail of pancreas	Residual pain
13....	Heavy	45	30	12	No	Yes	No	Yes	Yes	Incision and drainage	Good
14....	No	90	20	9.7	No	Yes	No	Yes	Yes	Incision and drainage	Good
15....	No	70	36	5.2	No	No	Tarry stools	No	No	Cystogastrostomy	
16....	Heavy	36	10	10.5	Yes	Yes	No	Yes	Yes	Incision and drainage Sphincterotomy	Good
17....	Moderate	65	50	10.2	No	Yes	No	Yes	Yes	Cystogastrostomy	Good

vealed bundle branch block. Blood sugar was 325 units. Hemoglobin was 7.5 gm. per cent; red blood cells, 2,510,000 per cu. mm.; white blood cells, 6,350 per cu. mm.; polynuclear cells, 59 per cent; lymphocytes, 29 per cent; monocytes, 1 per cent. Mean corpuscular volume was 101 per cent; mean corpuscular hemoglobin, 31 per cent; mean corpuscular hemoglobin concentration, 30 per cent. Twelve units of blood raised the hemoglobin to 10 gm. per cent. The patient refused to undergo exploration and left the hospital on June 12, 1955.

Readmission took place on June 30, when the patient noted tarry stools, pain in the chest and left arm, and nausea. The lateral roentgenographic view of the stomach at this time (Fig. 2) was interpreted as showing a retrogastric space top normal in size. At the time of exploration on July 15, the posterior wall of the fundus of the stomach overlying a 500 cc. pseudocyst showed a 3 by 3 cm. oval erythematous patch of mucosa which, when touched with the finger, began to bleed briskly. (Figure 3 shows a section through this oval patch revealing the extensive hemorrhagic infiltration of the area.) Transgastric cystogastrostomy was performed on this patient. A fatal pneumonia six weeks later allowed postmortem examination of the site of cystogastrostomy which now resembled a shallow gastric ulcer 2.5 cm. in diameter.

Dysphagia in this patient was not satisfactorily explained. The relationship of dysphagia to vomiting must be cleared by further observation. It will be noted in Table 1 that fourteen cases (77 per cent) were associated with vomiting. It is not known, however, whether many of these were regurgitation rather than vomiting. Figure 4 (Case 14) illustrates another dysphagic patient in whom the fluoroscopist reported the constant regurgitation of the ingested barium. This literally bounced back up from the middle and

FIG. 2. CASE 15. This retrogastric space, interpreted by roentgenologists as being within normal limits, contained a 500 cc. pseudocyst.

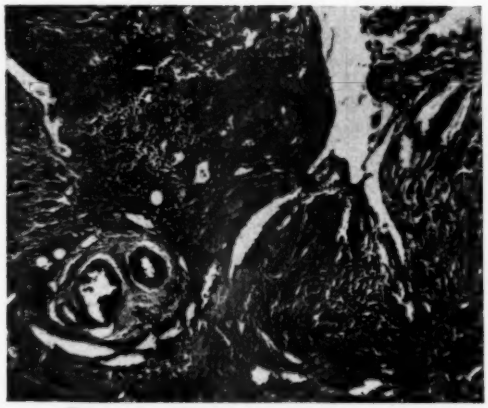


FIG. 3. CASE 15. The background of the recurrent hemorrhages in this patient is easily seen in this section of the wall of the pseudocyst on the left as it forces its way by steady erosion through the gastric mucosa, glands of which are shown on the right. Note the diffuse hemorrhagic infiltration and size of the vessels in the wall of the pseudocyst. This is obviously a process of long standing.

lower parts of the esophagus. The distortion of the polyethylene tube in this patient reveals the marked angulation at the cardia which might be a factor accounting for the dysphagia. In this patient, a constant slow drip of liquid by the tube was tolerated, but if this were speeded up enough to make the caloric intake worthwhile, a fullness rapidly turned into nausea and subsequent vomiting. Drainage of the cyst resulted in immediate loss of the dysphagia, nausea and vomiting. It is this frustrating feeding situation which calls for immediate surgical intervention to decompress the cyst rather than procrastinate and actually lose ground in an attempt to prepare these patients who are considered poor risks for surgery.

The presence of diabetes mellitus together with the aforementioned symptoms and signs may be helpful in judging the pancreas as the site of the trouble. Four patients (22 per cent) in this series had diabetes.

The treatment of pseudocysts has undergone an interesting evolution. Luche and Klebs [*17*] in 1866 drained a pseudocyst with a fatal outcome. Bozerman [*2*] in 1881 extirpated a cyst while Gussenbauer [*12*] in 1883 marsupialized a cyst. The first cystogastrostomy was performed by Jedlicka [*13*] in 1923.

In this series nine pseudocysts were drained. Four patients underwent subsequent surgical therapy elsewhere. Two had concomitant drainage of the cyst and division of the sphincter of Oddi. Two pseudocysts were resected. One patient underwent Roux's en Y cystojejunostomy and three underwent cystogastrostomy.

FIG. 4. CASE 14. Dysphagic patient. The small polyethylene tube is sharply angulated at the cardia. Whereas some of the barium passed onward, the greatest portion went down to the cardia and was regurgitated immediately.

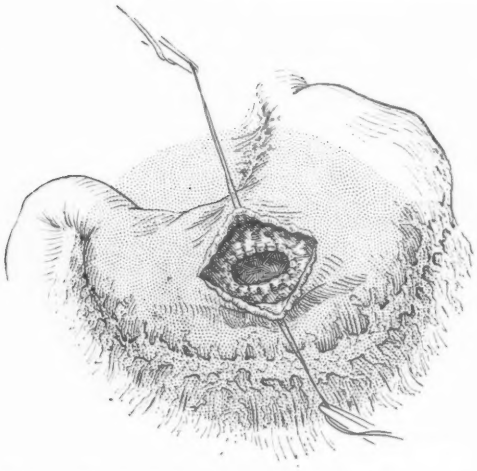


FIG. 5. Transgastric cystogastrostomy, an easy approach to the majority of pseudocysts of the pancreas. A 4 cm. anastomosis between stomach and cyst is performed by a locked stitch of chromic No. 1-0 catgut suture.

Our therapeutic preference is transgastric cystogastrostomy. (Fig. 5.) In this series the ease and rapidity of the operation, complete decompression of the cyst, rapid recovery of the patient and absence of external drainage were impressive. To be sure, the patients who underwent drainage or marsupialization overcame the acute emergency and were able to eat. However, the prolonged cumbersome drainage and hospitalization were distressing. In the series presented by Meyer et al. [*19*] the drainage time averaged 7.2 weeks. Babcock [*1*] pointed out that 15 per cent of marsupialized cases resulted in permanent fistulas.

Complications from excision of pseudocysts can be numerous as pointed out by Carter and Slattery [*4*]. Injuries to the common duct are prominent. Duodenal fistulas may also result from resection of pseudocysts on the right side. Resection of the pancreas in these instances may result in pancreatic insufficiency. If there has been prolonged pressure on the portal vein, extensive collateral circulation about the capsule may be present with resultant severe hemorrhage. On the left side, excision of a markedly adherent cyst may damage the celiac axis or, as in one case in our series, may result in such severe damage to the renal vessels that nephrectomy was necessary. It might be added that in pseudocyst, on the left side it may be extremely difficult to separate the kidney itself in this densely adherent field.

The eventual results from Roux's en Y cystojejunostomy (Case 4) and simultaneous drainage of the cyst and transduodenal sphincterotomy (Case 9) were good, but there was considerable morbidity, with a large pelvic abscess in the former and a duodenal fistula in the latter. Cystocholecystostomy has produced considerable emptying difficulty and therefore is not desirable [*2*]. Cystoduodenostomy has been associated with increased morbidity due to formation of fistulas [*13*].

Sinclair [*25*] reviewed forty-one cases of cystogastrostomy and commented on several of the interesting questions that would normally arise. Cattell [*5*] in 1952 suggested the inadvisability of cystogastrostomy due to the accumulation of large amounts of gastric content in the cyst cavity. Sinclair [*25*] pointed out that up to the time of his writing no one had been able to fill the cyst cavity postoperatively with barium, therefore there could not be much accumulation. It has been questioned whether the pancreatic enzymes are destroyed in cystogastrostomy. It has been shown by Spencer, Meyer, Rehfuss and Hawk [*26*] that trypsin retains its activity at room temperature for many hours in gastric juice having an acidity equivalent to 110 ml. 0.1N potassium hydroxide. Long and Muhleman [*16*] showed in 1914 that trypsin withstood acidity of 0.3 per cent hydrochloride for thirty minutes at 40°C. Grey [*11*] pointed out that in dogs the implantation of the pancreatic duct into the stomach for some months had no effect on the pancreas. Sinclair [*25*] further pointed out that in one hundred and thirty cases of pancreatic heterotopia gastric ulceration was present in only five.

Does alkali poured into the stomach defer digestion? Grey [*11*] in 1917 turned all the bile and pancreatic juice into the stomach and observed no fall in gastric acidity nor were there changes in the gastric mucosa. Similar negative results, as pointed out by Sinclair [*25*], have been exhibited by Tripodi and Sherwin [*27*], Person and Glenn [*20*] and Ferguson and Wangensteen [*10*].

In general, the over-all follow-up cystogastrostomy is good as pointed out by Probstein [*22*] and Puestow [*23*]. Scholz and Kothe [*24*] present a discussion of complications and

cystogastrostomy. They reviewed one hundred and twenty-two published cases of cystogastrostomy and added nine cases of their own. Of the one hundred and thirty-one cases four deaths occurred (3.8 per cent) which were caused by erosion, hemorrhage, pancreatic necrosis, putrid infection and suture insufficiency. These authors present a case in which they roentgenologically demonstrated patency of the cyst after a year. They also demonstrated gastritis along the margin of cystogastrostomy in another case in which the cyst failed to close. Maxeimer and Maxeimer [*18*] report a fatality after cystogastrostomy resulting, they claim, from the ulcer which occurred after anastomosis. Whether this is a coincident ulcer at the anastomotic site is hard to discern from the report. In the relatively few cases of residual pain and dyspepsia, the logical approach might well be sphincterotomy [*26,27*], with pancreatogram and further definitive therapy depending on the findings of the pancreatogram.

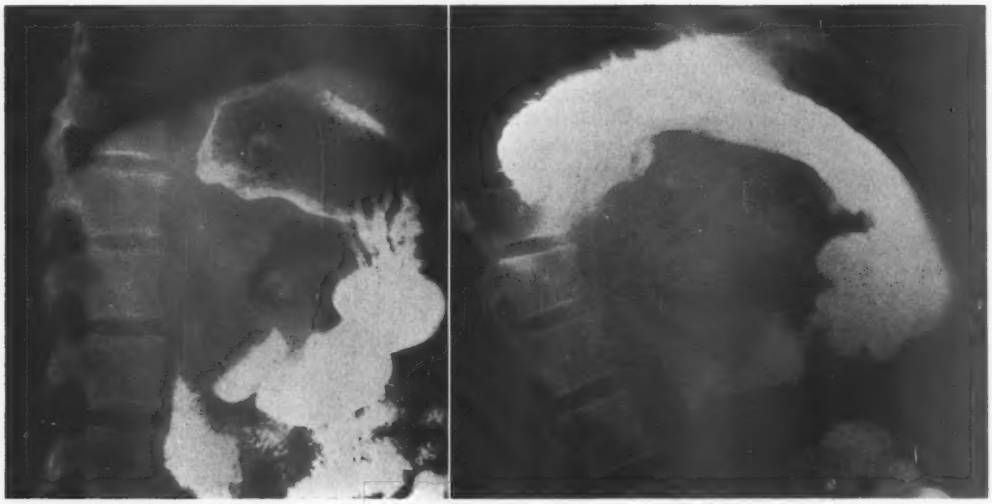
Case 17. M. F., a forty-seven year old woman, was admitted to the Philadelphia General Hospital on October 31, 1957, with a two-year history of intermittent epigastric pain radiating around the right side to the flank. The pain, occurring particularly after eating, was not relieved by milk or Banthine,® but was occasionally helped by antacids. Moderate intake of wine was admitted. An upper gastrointestinal series and cholecystogram performed in the Surgical Clinic previously were negative for abnormalities with the exception of postbulbar irritability. In the last few weeks before admission, there had been moderate exertional dyspnea with the occasional use of two pillows for sleeping.

Physical examination revealed a slightly distended abdomen with diffuse tenderness most marked in the epigastrium. There were no palpable masses. Blood pressure was 110/85 per minute; pulse, 118 per minute; respirations, 22 per minute. Temperature was 39°c.; serum amylase, 915 Somogyi units. Hemoglobin was 12.2 gm. per cent; white blood cells, 9,300 per cu. mm. (6 stab forms, 2 segmented neutrophils, 17 lymphocytes, 5 monocytes, 1 eosinophile). Serum calcium was 10.1 mg. per cent. X-ray film of the chest revealed an elevated diaphragm bilaterally.

Levin tube suction and parenteral fluids were begun on admission. The patient felt excellent by November 3; therefore, the tube was removed and clear liquids begun orally. This was tolerated well and a bland diet was begun on November 4. With the recurrence of back pain the Levin tube suction was reinstituted on November 5 and continued for three days when she was once again given oral liquids. She tolerated this regimen well until November 15 when vomiting occurred together with severe abdominal pain. Levin tube suction was again used. Paracentesis on November 22 yielded 1,000 cc. of straw-colored fluid. At this time serum protein was 3.8 gm. per 100 cc. and hemoglobin 10.2 gm. per cent. Phlebothrombosis was noted in the left leg the next day. Paracentesis was repeated on November 29 yielding 1,300 cc., the amylase level of which was 996 units. Serum amylase on this day was 729 units. Serum calcium was 8 gm. per cent. Upper gastrointestinal series performed on this date was negative for abnormalities. (Fig. 6A.) On December 4 and 5, particularly severe upper abdominal pain was relieved by an indwelling epidural catheter using 15 cc. of 0.25 per cent xylocaine. On December 7 and 9, the patient received 25 gm. of albumin in an attempt to correct the serum albumin of 1.9 gm. On December 15 a repeat gastrointestinal series (Fig. 6B) revealed marked anterior displacement of the stomach. An epigastric mass was now palpable for the first time. The patient underwent transfusions on December 16, 17, and 18, and on December 19 transgastric cystogastrostomy was performed with the patient under continuous spinal anesthesia. (Initially, 150 mg. of procaine was administered followed by four doses of 50 mg. in 20 minute intervals. Supplemental doses of 5 per cent sodium pentothal and Neo-Synephrin® were also administered.) Approximately 2,500 cc. of brown fluid was present in the pseudocyst. On December 21, the second postoperative day, serum amylase was 89 units and the patient was sitting up in bed. By December 23, the Levin tube was removed and the patient given surgical liquids orally. By December 26, she was placed on a solid diet, had an excellent appetite and a sense of well being. The patient was discharged to the Surgical Clinic on January 4, 1958 and six months later was reported to be feeling fine.

Comment: It is probable that adequate lateral views of the stomach during the early phase of the vomiting episodes would have antedated the actual diagnosis by several weeks. Instead, chief emphasis at this point was placed on fluid balance.

It is quite probable that this patient should have undergone exploration back around November 15, 1957, on the basis of her clinical symptoms. Formation of a pseudocyst should have been suspected more acutely. Whereas the gastrointestinal series performed on November 29 reported a normal retrogastric space, it is quite certain that there was already a large collection of fluid therein. (It is noteworthy that the left side of the diaphragm was fixed



6A 6B

FIG. 6A and B. A, first true lateral view taken of this patient interpreted as having a normal retrogastric space. B, sixteen days later there was obviously a huge retrogastric collection.

in a low position by previous inflammation [Fig. 6C] while the right side was elevated.)

CASE 10. P. T., a thirty-nine year old man, was admitted to the Philadelphia General Hospital on September 1, 1955, with a five-month history of intermittent epigastric and left upper quadrant pain radiating to the scapula. The pain was frequently brought on by ingestion of alcohol and accompanied by vomiting. The patient showed marked agitation, confusion and hallucinations. He showed diffuse tenderness and tympany of the upper part of the abdomen with absence of bowel sounds. Hemoglobin was 16.1 gm. per cent; serum amylase, 440 Somogyi units; serum lipase, equivalent to 6.5 ml. 0.2N sodium hydroxide. Temperature was 39°C.; serum calcium, 8.6 mg. per cent. The psychotic state lasted through September 8. Distention of the abdomen continued through September 14 requiring Levin tube suction and intravenous fluid therapy. Oral feedings were begun on September 15 at which time the abdomen was flat and non-tender. Cholecystogram at this time revealed non-function of the gallbladder. An upper gastrointestinal series was within normal limits. He was discharged to the Surgical Clinic on September 20 feeling good. In the following three months he exhibited moderate postprandial pain intermittently with a few episodes of sharp pain following the ingestion of alcohol.

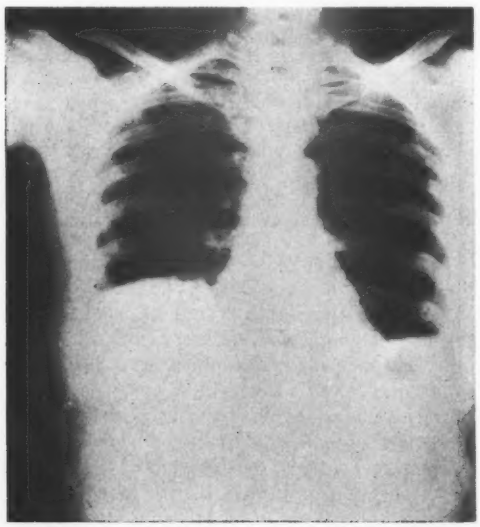


FIG. 6C. The low fixation of the left diaphragm might be a clue to previous pancreatic inflammation. Diaphragmatic elevation is limited to the right leaf despite the fact that the bulk of the cyst is on the left. The fluid in the costophrenic angles should be tapped and examined for amylase content as soon as it is discovered.

The patient was readmitted to the hospital on December 14, 1955, with diffuse tenderness and a temperature of 39°C. Serum amylase was 364 Somogyi units; serum lipase, 4.1 units; hemoglobin, 9.1 gm. per cent; prothrombin time, 36 per cent. With resumption of peristalsis and flattening of the abdomen seventy-two hours after admission, an upper gastrointestinal series revealed distortion of the stomach as shown in Figure 4. Following the intravenous administration of Mephyton,® cysto-

gastroscopy was performed on December 31 at which time 6,000 cc. of dark brown fluid was aspirated from the cyst. A soft diet was begun in six small feedings on January 1, 1956 and the patient was discharged on January 17 in good condition.

Clinical follow-up on March 3 and August 3 reported the patient to have "very occasional pain," and that he felt good generally. The patient claimed that he had stopped drinking and had recovered his appetite but failed to gain back any of his 20 pound weight loss. The patient attributed this to a scanty diet associated with his depleted economic state.

Comment: Repeat upper gastrointestinal series a month or two following his first discharge would probably have revealed the pseudocyst and led to earlier therapy.

SUMMARY

Seventeen cases of pseudocyst of the pancreas are presented. A long period of study is frequently performed on these people during which their condition deteriorates. The symptom complex of anemia, gastrointestinal bleeding, dysphagia or vomiting, and pleural effusion, in addition to pain, is emphasized to hasten the examiner's focus on the pancreas. Prompt transgastric cystogastrostomy is suggested as the procedure of choice in these patients who are poor risks.

Following the subsidence of acute symptoms in known cases of pancreatitis, an early true lateral roentgenographic view of the stomach is indicated to give a baseline measurement of the retrogastric space. Formation of a pseudocyst may thereby be suspected before the patient goes on to the relatively late stage characterized by a palpable mass.

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Postoperative Psychosis in the Aged

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PSYCHOSIS is an infrequent but important complication of the postoperative period. It belongs to a group of related conditions described as post-traumatic or toxic psychoses which may occur following injuries with or without damage to the brain, burns, severe electrolyte imbalance, etc. [1,2]. The term "postoperative psychosis" does not identify an independent entity of mental deterioration since various psychotic syndromes were observed following operations.

MATERIAL AND METHODS

This report is based on our experience with acute psychoses following fifteen operative procedures in eleven patients. Three patients underwent repeated operations. The absence of psychosis at the time of admission was the prerequisite for the selection of the cases although the reduced psychic reserve of most patients was recognized. Psychotic episodes which appeared several months following an operation were not included in this presentation. These eleven patients were observed following the performance of 2,000 major and minor operative procedures.

All our patients were males between fifty-four and seventy-eight years of age, the average being sixty-six. One was a Negro.

PREDISPOSING FACTORS

Family and Past History. The family history of our patients was not remarkable except that the father of one patient had committed suicide. One patient had a history of occasional confused behavior and three patients were chronic alcoholics.

Personality Pattern. At the time of admission, one patient did not exhibit any unusual personality traits. He died with acute renal failure. Two patients had well preserved intellectual faculties, a good or even sharp memory and they were professionally active. However, they were oversensitive, apprehensive, unstable, suspicious and they responded to stress with undue anxiety. Both patients had refused surgery at first and only after repeated reassurances and at the insistence of the surgeon were they willing to consent to an operation.

The remaining eight patients were classified as presenile. They were quiet and well liked persons. They were easy to manage except under stress when they became stubborn, uncooperative, querulous or hostile. Their intellect did not appear to be grossly defective most of the time, but their memory was fading. All eight were considered to be marginal cases with reduced psychic reserves.

Anatomic Changes in the Central Nervous System. Elderly patients frequently have cerebral arteriosclerosis, and a diminished cerebral blood flow makes them very susceptible to delirious reactions [3,4]. Their physiologic and psychic balance is precarious and exceedingly vulnerable to cerebral anoxia [5]. A similarly lowered threshhold can be expected in patients who have suffered direct damage to the central nervous system. Three of our patients had had previous cerebrovascular accidents.

CONTRIBUTING FACTORS

Change in Environment, Isolation, Inactivity and Immobilization. Admission to a hospital represents a considerable stress for many people. They are surrounded by strangers in what appears to be a hostile environment due to the discomfort of the diagnostic and therapeutic procedures. The comfort of the patient's daily life is disrupted and he is forced to accept an unfamiliar routine. While such environmental changes are easily absorbed by the average patient, the simple experience of hospitalization

may precipitate a psychosis in the elderly person who has lost his resilience for such adaptations [6]. The visits of friends and relatives may be rare and insufficient to satisfy the patient's need for companionship. Thus hospitalization means isolation, which is well recognized as a breeding ground for psychic disorganization. We frequently observe the beneficial emotional effect of removing the patient from the monotony of a single room to the ward.

Inactivity is another hazard. The professionally active person especially will suffer under the strain of an enforced idleness. Both isolation and inactivity may be magnified by immobilization, such as the application of a plaster cast or orthopedic traction. The physiologic dangers of immobilization are well recognized today. Its psychic impact is just as damaging. Immobilization as a major cause of post-traumatic and postoperative psychosis was described by Titchener and his associates [7], and it is well demonstrated by the following case.

G. A. A. (No. 127267), a sixty-five year old white man, had a history of a previous cerebrovascular accident, and he underwent excision and grafting of a right ileofemoral aneurysm in April 1958. Postoperatively, his hip was immobilized by a spica cast for two weeks. On the fifth postoperative day the patient became confused, agitated and tried frantically to remove his bandages and his cast. Relatively lucid periods alternated with stages of hallucination, confusion and agitation. Following the removal of the cast, the patient rapidly regained his apparently normal mental status. In July 1958 he underwent excision and grafting of a left ileofemoral aneurysm with immobilization for a period of two weeks. Prior to the operation we tried to explain the need for the cast to the patient, and we asked for his cooperation. On the fourth postoperative day, an acute psychosis developed. It was less violent than the preceding one and lasted for only four days. The recovery was complicated by thrombosis of the femoral artery, and amputation was performed in August 1958. Following this operation immobilization was limited to the minimum. A mild psychotic episode developed on the second postoperative day. It subsided after three days without noticeable residuals. In this case, immobilization appeared to be the main factor in provoking the postoperative delirium.

Toxic Factors. Cerebral anoxia seems to be the main cause of psychosis induced by various toxic factors. One of these is the disturbance of the fluid-electrolyte balance. Changes in the fluid-electrolyte balance may cause irritability, restlessness, apprehension, confusion, hallucination and, in the severe form, stupor and coma. Hydration and the correction of the electrolyte disturbance will restore, as a rule, the normal nervous and psychic responses. Uremia is noted for causing various forms of psychosis [8]. The retention of the waste products and the associated fluid and acid-base imbalance may result in irreversible damage to the brain. On the surgical ward, acute renal failure is a fairly common cause of such toxic psychoses.

C. C. J. (No. 126423), a sixty-six year old Negro man, had resection and grafting of an abdominal aneurysm of the aorta in May 1958. He was previously treated for generalized arteriosclerosis and arteriosclerotic heart disease. On the first postoperative day, he exhibited an unusual degree of restlessness and apprehension. A total of 2,300 ml. of gastric juice was removed through the gastric tube. The urine output was 200 ml. On the second postoperative day, the urine output fell to 5 ml. and the gastric drainage had increased to 3,000 ml. The plasma bicarbonate was 35 mEq./L., the chlorides 77 mEq./L., and the blood urea nitrogen 51 mg. per cent. Extreme restlessness and apprehension developed and the patient was delirious intermittently. On the third postoperative day, the fluctuating level of consciousness deepened into coma. In the terminal phase, muscular twitching and a convulsion preceded death.

Sedatives and Narcotics. Sedatives and narcotics, especially opium derivatives and barbiturates, are noted for their tendency to produce delirium in hypersensitive persons. Their depressing effect may also accentuate cerebral anoxia in the aged and in the anemic patient [9]. The resulting apprehension, agitation and delirium may easily demand more sedation which will only perpetuate this vicious circle. Hammes [10] estimated that the most common type of psychosis in the postoperative period probably results from a combination of cerebrovascular insufficiency and toxic reactions to sedatives and narcotics.

Anemia. The frequency of psychoses following gastrectomy was observed by Regan and Rowe [11]. Three of our patients had partial gastrectomies, one had had partial gastrectomy one year prior to admission, and closure of a perforated peptic ulcer had been performed in another. This remarkable frequency was par-

tially explained by the fact that patients with peptic ulcers represent an increased psychosomatic and psychiatric risk. However, we believe that anemia was another major contributing factor in the development of postoperative psychoses since all these operations were performed in the presence of acute or chronic blood loss. Syncope is the most common response to cerebral anoxia in cases of severe hemorrhage but, in the presence of other factors, delirium may develop [9]. A severe gastrointestinal hemorrhage may cause ammonia intoxication and psychosis in the presence of decreased liver function [12], but none of our patients showed evidence of gross liver failure.

Miscellaneous Causes. There are various etiologic factors in postoperative psychosis which were not observed among our patients but are worthy of mention. Psychoses following thyroidectomy are relatively well documented. Both hyper- and hypothyroidism were implicated as the main cause [13,14]. In the presence of fractured long bones, cerebral fat embolism was indentified as the cause of psychosis [15].

Type of Surgery and Anesthesia. A psychosis may follow any type of surgery. In females, operations on the genital organs predominate as the cause of psychoses [16]. In the aged, immobilization for any reason carries considerable risk. Our operative procedures included three partial gastrectomies for acute gastrointestinal hemorrhage, one exploratory laparotomy for acute gastrointestinal hemorrhage, one closure of a perforated peptic ulcer, one repair of an incisional hernia in the presence of chronic gastrointestinal hemorrhage, one cholecystectomy, three cases of excision and grafting of aneurysms, one endarterectomy, one amputation of the leg, one amputation of the penis, and one case each of intramedullary nailing and removal of an intramedullary nail.

All our patients had a routine general anesthesia consisting of thiopental, succinylcholine, nitrous oxide and/or cyclopropane. There is no reason to believe that the anesthesia had any relationship to the development of the ensuing psychic derangement.

The psychiatric evaluation of the patient is difficult during the first twenty-four hours after surgery, due to the residual effect of the anesthetic agents. Excessive discomfort also may alter the patient's reactions. Delirium during this period was called "postanesthetic psychosis" [17] and it should be differentiated from postoperative psychosis as we define it. Summing up the etiologic mechanism, acute postoperative psychosis is the result of various factors causing cerebral anoxia in persons with a vulnerable psychic make-up. In the person who is severely predisposed, the toxic factor may be minimal. The opposite is also true. A severe toxic influence may precipitate a psychosis in a stable patient who can tolerate stress well. The presence of multiple etiologic factors is the rule.

CLINICAL COURSE

While all types of psychotic reactions were described during the postoperative period, all our patients exhibited uniform characteristics and they were classified as acute brain syndrome or acute delirium. In our experience, the acute psychosis is a complication of the early postoperative period. It becomes manifest during the first postoperative week and lasts from a few days to a few weeks. During these days, the physiologic and psychic reserves of the patient wane due to nutritional deficiencies, blood loss, electrolyte disturbance, discomfort and malfunctions of the gastrointestinal and urinary organs. Both the physiologic and emotional stress are greatest during these days. With the return of the normal physiologic functions and with the subsiding of the discomfort, the chances of a psychiatric breakdown lessen.

The beginning of the psychotic reaction may be insidious or abrupt. The intellectual functions are poor indicators during the first few postoperative days because of the patient's discomfort. Also restlessness, apprehension and insomnia are difficult to interpret because of their frequency during these early days of recovery. However, any such symptoms of excessive dimensions should be considered as a possible premonitory sign. The occurrence of confusion, disorientation, hallucination, acute anxiety and hyperkinetic states helps to establish the diagnosis. Speech is frequently slurred and incoherent. Sweating, tachycardia and tachypnea may be observed during the episodes of agitation. The surgeon is often alerted by the nurse who reports that the patient is climbing out of bed, or has pulled out his catheter, gastric tube or intravenous needle. These interruptions of treatment are, as a rule, not serious. However, repeated venipuncture or the reinsertion of the gastric tube

may be impossible in an acutely agitated patient. The night increases the isolation in the darkness and appears to aggravate the condition. Although the patients were confused and were hallucinating in the solitude of their room, they were often able to control their intellectual functions during the visits of the physician. The intensity of the psychosis was fluctuating and lucid intervals were not uncommon. Insight was present at times.

Psychosis due to the toxic factors of a severely disturbed metabolism has a somewhat different character. As a rule, it rapidly advances into a stupor or coma. The agitation may be accompanied by tremors, twitching of muscles or convulsions—a dreaded stage of deterioration.

PROGNOSIS AND SEQUELAE

In general, the prognosis of this acute postoperative psychosis is good and most patients will recover without noticeable residuals. Two of our patients died. In both instances the psychosis was the by-product of an irreversible metabolic derangement. A psychosis rapidly deepening into coma is certainly an ominous prognostic sign. One patient developed a permanent psychotic condition.

G. M. (No. 127581), a sixty-four year old white man, was admitted to the hospital in May 1958 with a fracture of the left hip. His alcoholic intake was great and, according to his friends, he behaved "strangely" at times. At the time of admission, his mental status was not grossly deficient although he was considered a definitely presenile personality. He was placed in orthopedic traction but tolerated it poorly. He became confused and restless. Following intramedullary nailing, he developed a full-blown acute delirium which gradually subsided after one week. The recovery was complicated by a wound infection and the patient remained immobilized in bed. Intermittent episodes of confusion have persisted.

He was returned to the operating room for removal of the intramedullary nail and drainage of an abscess. His postoperative course was again complicated by an episode of hallucination and agitation which lasted for several days. His mental status never became completely lucid. As wound infection and immobilization continued, we had the impression that his mental deterioration definitely progressed and that the diagnosis of a chronic brain syndrome was warranted. It seems that in predisposed elderly persons, the persistence of the provoking agents will produce a state of irreversible mental derangement.

PREVENTION

While the emotionally unstable person and the elderly person with marginal psychic reserves are not uncommon in our hospital population, we were not able to predict which patient would be affected. Adequate preoperative preparation and meticulous postoperative care appear to be the main preventive measures. Anemia and fluid-electrolyte derangement should be corrected, narcotics and sedatives should be used judiciously, and isolation and immobilization should be limited to the minimum. The significance of an unhurried visit of the surgeon and the anesthetist prior to operation is recognized. In our small series, three patients underwent repeated operative procedures and all three developed a subsequent episode of psychosis. This suggests that in a patient with a history of postoperative psychosis, an operation of similar magnitude will precipitate another attack.

TREATMENT

The development of a psychosis in the early postoperative period is a major emergency and it demands immediate attention and intensive care. The first consideration is accident prevention. Mechanical restraints are mentioned by many writers with a sense of uneasiness, yet they are not a humiliating but a life-saving measure. A special attendant is almost always required, but he would not be able to restrain an agitated patient. The use of several attendants around the clock is impractical. Side rails, by their design and by increasing the distance of a fall, only increase the chance of injury. One cannot rely on drugs in this stage of the disease. They may not affect the patient, or they may affect him adversely. Restraints also prevent the patient from interfering with the vital postoperative care. Management of the aged person allows little margin for error; a deranged homeostasis certainly will aggravate the psychosis. Thus, all measures must be utilized to secure the uninterrupted administration of postoperative care. We observed repeatedly that the frightened and restless patient was pushed into panicky excitement when further restraints were imposed. In such cases, the alleviation of the acute anxiety by drugs is imperative.

While drugs create the danger of introducing potentially toxic chemicals, they are very important in the management of the psychotic

patient. We relied on routine analgesics and sedatives because the absence of pain and discomfort may be a curative factor. Promazine and chlorpromazine were very valuable in the management of the apprehensive and hyperkinetic patient. The possible toxic effect of chlorpromazine did not detract from its usefulness. The only restricting consideration in the use of these agents was their possible hypotonic effect in the early postoperative period although we did not observe such adverse reactions. Both the toxic and hypotonic effect of the phenothiazines are supposed to be eliminated by the new anticonfusion drug alpha-(4-piperidyl) benzhydrol hydrochloride (Frenquel®) [*18*]. Our experience with this agent is not adequate to confirm its superiority over other drugs. In the milder cases we were satisfied with close supervision of the patient without the use of restraints or drugs.

All our patients were satisfactorily managed by the previously mentioned methods. There was no need to transfer the patients to the neuropsychiatric section of the hospital for specialized care. It seems that the majority of these patients can be handled adequately by the surgeons although the assistance of the psychiatrist was always appreciated.

SUMMARY

Fifteen episodes of acute postoperative psychoses were observed in eleven elderly patients. All cases were classified as acute brain syndrome or acute delirium.

The psychosis occurs in predisposed persons in the presence of various toxic factors which cause cerebral anoxia.

The treatment consists of elimination of toxic factors, correction of anemia or fluid-electrolyte imbalance, accident prevention and securing the uninterrupted administration of the postoperative care.

The prognosis is good. In the presence of persistent provoking agents, irreversible mental changes may develop.

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Regional Hypothermia and Its Effect on the Brain

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Although the mortality rate among patients with esophageal, gastric and duodenal bleeding has been greatly reduced since the introduction of intraluminal compression, the treatment is still not entirely satisfactory. In 1950 one of us (H. B. B.) showed that the use of a double balloon decreases esophageal, gastric and duodenal bleeding. The use of this double balloon was also an aid in the x-ray studies of these organs [2]. This research applied to studies done on the basic anatomy [4,5] of the gastrointestinal tract. It was found that the vessels supplying the stomach and duodenum perforated the muscular layer and entered a loose areolar area between the muscular layer and the mucosa, much as the ureter enters the urinary bladder. Because the above muscular layer is more resistant, and since the mucosa is soft and easily compressed, it is obvious that pneumatic compression by the introduction of air into this balloon would squeeze the mucosal sleeve against the muscular coat, thereby compressing the major vessels and arresting all bleeding in these organs. A cross section of stomach tissue with its blood vessels injected with radiopaque material demonstrates this thesis.

Wangensteen [8] reintroduced this principle in 1958. He used hydrostatic compression and perfused the balloon with a refrigerated solution of alcohol and water. The bleeding within the stomach ceased. We believed that it was compression by hydrostatic pressure and not the refrigerated alcohol and water solution that arrested the bleeding. Accordingly, we decided to investigate the temperature changes in the vessels of the stomach, the carotid artery and the brain, using the temperature of the pelvis as a control.

For some years we have used the air-inflated balloon to stop acute hemorrhages. The use of this procedure has resulted in a stable surgical patient who is able to retain transfused blood. Mortality and morbidity rates are greatly reduced with this method. The patient is then sent to surgery at the surgeon's convenience, not as an emergency case but as a well evaluated person. In the past, we have treated patients with catastrophic esophageal, gastric or duodenal bleeding as prime emergencies and maintained them by massive transfusions prior to, during and after surgery. These massive transfusions lead to another complication, namely, that of a citric acid overload and its associated citric acid poisoning, and hence excessive surgical and postoperative bleeding [7].

For some years we have induced hypothermia by internal cooling. We devised a cooling unit and a cam pump for this purpose. The blood was circulated through the cooling coil and then propelled through the vascular system by means of the cam pump [6]. Because this equipment was available, we used it in this experiment. At present we use a small commercial pump (Cole-Parmer Rota-flex) to circulate the coolant.

We wished to determine the effect of the cold balloon on the entire stomach and on its afferent and efferent blood vessels, as well as the reflected effect on the related organs. A comparative study was done with air distention, a coolant and distention, and a coolant without distention.

MATERIAL AND METHODS

Ten rather large dogs were used in this research. The cooling mechanism was the same

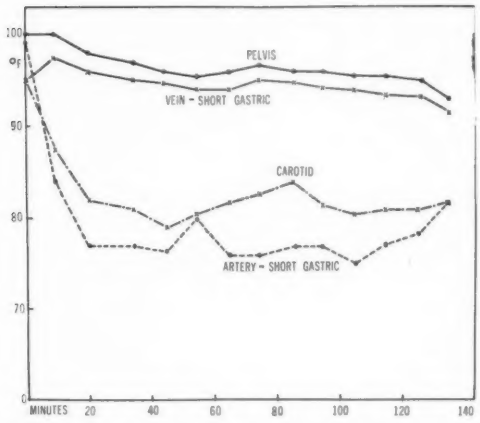

FIG. 1. Experiment B. This graph shows temperatures recorded when the balloon was placed in the stomach and perfused with a coolant, but with insufficient water to compress the mucous membrane against the muscular layer.

as that used for some years in our work on hypothermia by internal cooling [6]. The intragastric balloon was the same kind as the one described for tamponading the esophagus, stomach or duodenum for massive hemorrhage [3].

The dog was weighed, shaved and prepared for surgery in the routine fashion. The abdomen was opened transversely as for gastric resection. The common carotid artery was exposed, and a stab wound was made just above the pubic crest. Thermocouples were inserted into the carotid artery, left gastric vein, gastric artery and the short gastrics, as well as into the pelvis. The pelvis was used as a control point. All thermocouples were inserted into the vessels so as not to obstruct the blood flow. The wounds were then closed to avoid the recording of ambient temperatures and a base line temperature was taken. Trephining was performed in the skull, and the dura was incised. The thermocouple was inserted through the skull to make contact with the cortex of the brain. The double-lumen tube and balloon were inserted into the esophagus up to the stomach. The tube and balloon were previously calibrated, and a known volume of water and alcohol was introduced to distend the balloon to the walls of the organ. This procedure was also used with the balloon placed within the stomach. A comparison of both methods was then made. To prove that cooling of the stomach without distention had little or no effect on the animal, we used a large caliber polyethylene tube which was well insulated with Fiberglas® except for the distal loop. This was perfused with cold water, and the cold loop was inserted into the stomach. All the results of this experiment demonstrated no physiologic change.

A new procedure was then tried on an anatomic basis. We cooled the esophagus to determine the cooling effect on the brain. This was done because of the relationship of the arterial and venous blood flow to and from the brain along the esophagus. Since the esophagus lies between the carotid arteries as well as near

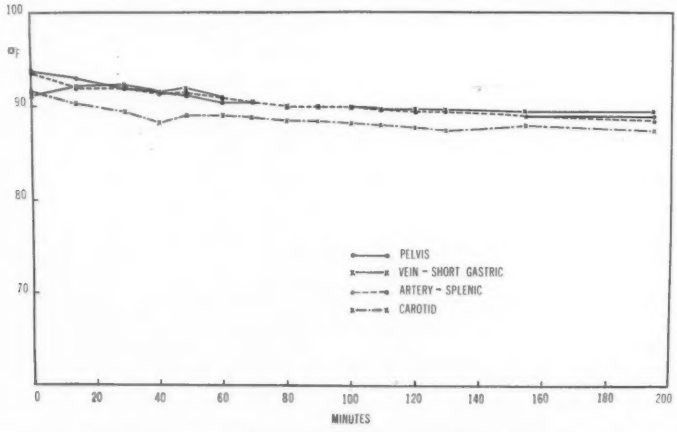

FIG. 2. Experiment D. This graph shows temperatures recorded when the balloon was fully distended with air. No coolant was used but compression of the mucous membrane against the muscular layer was complete.

the arch of the aorta and its descending branch, we believed that a cooling balloon placed in this organ might cause regional hypothermia of the brain. Our efforts to prove this theory were successful. The brain became more compact. The carotid sinus reduced the blood flow to the brain and the cold plasma became more avid for oxygen uptake as we had noticed in previous hypothermia ventures. We now dealt with a smaller brain that was nourished adequately by a smaller volume of blood. This is an ideal state for brain surgery. Figure 1 (experiment B) is a composite graph showing the difference in the recorded temperatures using a deflated balloon with a coolant in the stomach. This may be compared with Figure 2 (experiment D) when air was used to distend the organ. Figure 2 does not have as wide a range of temperature differential as that shown in Figure 1, but the bleeding did stop as readily. Figure 3 reflects the activity in the first experiment when the balloon was inserted into the esophagus. The importance of this experiment is its demonstration of temperature reduction of the brain by regional cooling instead of body cooling.

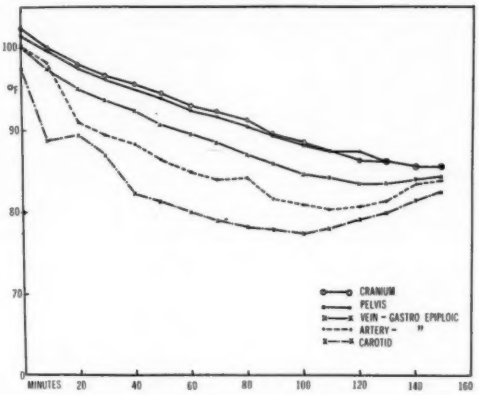

FIG. 3. Experiment I. This graph shows the temperatures recorded when the balloon was adapted to the lumen of the esophagus. No distention was used, only approximation by means of previous calibration. A coolant was used.

COMMENTS

We found that the compressive force of both air distention and cold hydrostatic pressure within the stomach arrest the bleeding within this organ. Both methods reduce the production of acid pepsin and, therefore, digestion because of the reduced blood flow within the organ. Both methods have been used on experimental and clinical levels with marked success. A moving coolant within a balloon inserted into the esophagus (and not into the stomach) caused a pronounced reduction of the blood flow and temperature in the carotid arteries and the brain. This was caused by the reflected cooling, from the balloon within the esophagus, on the flowing blood within the carotid arteries and the carotid sinus. In this experiment, the temperature of the brain fell rapidly. The brain was reduced in size because the volume of blood to this organ was less than normal. However, since cold blood carries a greater oxygen content, the brain remained well oxygenated in this hypothermic state. This is an optimum condition for neurovascular surgery. It is an ideal situation because the whole animal is not placed in an equivalent hypothermic level. This is clearly shown by Figure 3. Table 1 shows the temperatures recorded from the major vessels involved as well as the temperatures recorded in the cortex of the brain. The drop in temperature with the cold balloon within the stomach is obvious. The bleeding was arrested just as effectively when air alone was introduced to compress the mucous membrane to the muscular coat of the stomach. The only advantage in the use of a moving coolant in the balloon was that of cooling the brain. This was most pronounced when the cooled balloon was in the esophagus. The temperature of our reference point, the pelvis, was also reduced after a period of time, but this reduction was greater when a coolant was used than when only pneumatic pressure was exerted.

SUMMARY

We believe that air distention in a pneumatic balloon is superior to cold hydrostatic pressure in a balloon to arrest gastric bleeding and to reduce gastric digestion. This is true because air pressure may be used on the subject without an anesthetic. Excessive cold causes pain, but air distention of the balloon causes no distress. Digestion in an actively bleeding stomach is held to a minimum without any chemical or physical intervention. In the stomach, a large balloon uniformly distended by air does not cause abdominal pain or distress, and does not affect the pulse. It never causes the heart to develop an abnormal rhythm.

On the other hand, the use of a cooled balloon in the esophagus appears to be an ideal tool for

TABLE I

RECORDED TEMPERATURES (IN DEGREES FAHRENHEIT)

Experiment No.	Carotid Artery			Short Gastric Vein			Short Gastric Artery			Control: Pelvis			Brain			Time Span (min.)
	Initial	Terminal	Differential	Initial	Terminal	Differential	Initial	Terminal	Differential	Initial	Terminal	Differential	Initial	Terminal	Differential	
A. Balloon in stomach, cold water, no distention	90	78.5	11.5	86	84.5	1.5	91†	84.5	6.5	93	84.5	6.5	.....	....	....	171
B. Balloon in stomach, cold water, no distention	95	81.8	13.2	95	91.5	3.5	99	81.8	17.2	100	93	7.0	.....	....	....	135
C. Balloon in stomach, air-filled, no distention	94	91	3.0	98	92.2	5.8	97‡	93	4.0	98	91.2	6.8	.....	....	....	218
D. Balloon in stomach, air-filled, complete distention	91.8	87.5	4.3	91.2	89.5	1.7	93.8§	88.5	5.3	93.8	89	4.8	.....	....	....	195
E. Coiled tubing in stomach, cold water circulated	93	78	15.0	93	82	11.0	95.5†	83	12.5	97	84.2	12.8	.....	....	....	145
F. Balloon in stomach, air-filled, no distention	95.2	90	5.2	94.9	93.5	1.1	96†	94.4	1.6	97.5	94	3.5	.....	....	....	140
G. Balloon in stomach through incision, cold water, complete distention	97	81.5	15.5	98	68	30.0	98	....	....	97.5	81	16.5	.....	....	....	120
H. Balloon in esophagus, cold water	99.6	84.8	14.8	100*	92.6	7.4	99.8¶	92.2	7.6	99.8	94	5.8	.....	.....	.....	100
I. Balloon in esophagus, cold water	97.5	82.5	15.0	100.2*	84.5	15.7	100.2¶	84	16.2	101.5	85.8	15.7	103.5	85.8	17.7	150
J. Balloon in esophagus, cold water	95	83.5	11.5	.....	....	....	.....	....	....	....	....	....	98	87.6	10.4	120

* Gastroepiploic vein.
† Left gastric artery.
‡ Right gastric artery.
§ Splenic artery.
¶ Gastroepiploic artery.

the neurosurgeon. Barnard [1] summed up the value of hypothermia in brain surgery by stating that "if procedures could be rendered sufficiently safe, the fields of aneurysmal surgery and other vascular neurosurgery could be extended." The use of this procedure is especially indicated because it temporarily reduces the size of the brain by reducing the blood volume within the vessels of the brain while it increases the oxygen tension of the blood plasma.

Thus, the air-distended balloon is sufficient to stop bleeding alone, but the circulating liquid-cooled balloon in the esophagus is the instrument of choice for brain surgery.

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Ulcerogenic Non-beta Cell Pancreatic Islet Carcinoma

STUDIES ON THE EXTRACTION AND ASSAY OF A POSSIBLE GASTRIC SECRETAGOGUE

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CLINICAL and experimental evidence has accumulated to suggest various relationships between endocrine and exocrine pancreatic functions and gastric acid secretion. It is well known that hyperinsulinism, with or sometimes without islet cell insulin-producing tumors, occasionally leads to peptic ulcers [1]. Clinical and experimental observations have shown that total diversion of pancreatic secretion from the area where gastric contents enter the small bowel may be associated with peptic ulceration [2]. On the other hand, ulcers rarely appear when total pancreatectomy deprives the gastrointestinal tract of pancreatic secretion and at the same time removes endocrine secretions [3]. Dragstedt [4] has reported that almost all dogs with external pancreatic fistulas develop gastric or duodenal ulcers, while peptic ulceration is quite unusual in dogs following total pancreatectomy. These observations suggest that an endocrine factor originates in the pancreas and serves as an excitant for gastric acid secretion.

Three reports [5–7], have characterized non-beta cell pancreatic islet tumors. These tumors are associated with high rates of gastric acid secretion, extensive and intractable peptic ulceration, usually with malignancy and metastases of the islet cell tumors themselves, and with ultimate death. They have stimulated consideration of a possible endocrine interrelation between pancreatic islet function and gastric secretion. Clinical studies of gastric secretion in patients with this syndrome have been reported [8]. It has been shown that glucagon given intravenously does not activate acid secretion from the isolated gastric pouch of a dog [9] nor does it cause elevation of blood pepsinogen [10], and it seems unlikely that the tumors' effects are mediated by that substance.

In a recent review on pancreatic surgery, Warren and Cattell [11] discussed the ulcerogenic islet cell tumors and stated, "The ultimate significance of these tumors will depend upon a demonstration that they secrete an activating substance responsible for the bizarre peptic ulceration." Donaldson, vom Eigen and Dwight [12] reported a case of gastric hypersecretion, peptic ulceration and islet cell tumor of the pancreas leading to death. This report (1957) included a detailed review of this subject.

Drs. John D. Houghton and Robert Dean of the Pathology Department of the Boston Veterans Administration Hospital kindly provided for our study a small sample of tumor tissue which had been obtained at the autopsy of this patient and kept in a frozen state. We sought any gastric secretagogue which might be found in this tumor tissue, using Heidenhain pouch dogs [13] and observing changes in the pH of the pouch secretions when intravenous extracts from the tumor were given to the animals.

MATERIAL AND METHODS

A small quantity (2.2 gm.) of tumor tissue (from the patient of Donaldson, vom Eigen and Dwight) which had been kept in an ordinary freezer for a period of two years was used to

make a preparation for testing. The tumor tissue was divided into two samples weighing 0.9 gm. and 1.1 gm. (wet weight). Sample A was fragmented in a Potter-Elvjhem homogenizer and triturated from a frozen state into 10 cc. of normal saline solution. This was dialyzed for forty-eight hours at 4°C. in a cellophane bag (Visking tubing) against 40 cc. of normal saline solution. Tumor sample B was similarly homogenized into 10 cc. of normal saline solution but was dialyzed for twenty-four hours against 30 cc. of normal saline solution. For control studies, 2 gm. of liver, derived from fresh human autospy material, was triturated into 20 cc. of saline solution and dialyzed against 60 cc. of water. Likewise, 6 gm. of fresh frozen human pancreas was prepared with 20 cc. of saline solution, centrifuged for thirty minutes to permit elimination of fat droplets, and the supernatant solution dialyzed against 300 cc. of water for thirty-six hours. In each case, the dialysate as well as the residuum was kept at −4°C. and was melted at room temperature just prior to its use for testing. Dialysates were given intravenously to experimental dogs as indicated in Table 1. Residuums were cleared by centrifugation and the supernatant fluids employed for the tests.

Heidenhain gastric pouches [*13*] were prepared in two 25 pound mongrel dogs. Pouches of about 50 cc. maximum volume were made by isolating the cardia and a portion of the fundus from the stomach and its vagus nerve supply, and closing the cut edge of this pouch. The vascular supply was then derived from splenic and omental connections. One end of the closure line was exteriorized to form a stoma through which secretions could be recovered by insertion of a glass tube.

For these short experiments only qualitative changes in pH were measured on hourly samples. Long-term collection of secretions was not attempted. The preparations of tumor, human pancreas and liver, as well as glucagon and saline solutions, were given intravenously. The effect of feeding and of subcutaneous administration of histamine was observed. The pH measurements were made with the Beckman pH meter using glass electrodes. For each test the pouch was emptied with a glass tube. If the secretion recovered was above pH 4, the test was undertaken. Most initial pH values were near neutrality. (Table 1.) Fasting for at least twelve hours seemed necessary to avoid an acid pouch secretion. Samples were taken successively at hourly intervals until a near neutral or alkaline state was observed so that a stimulus to acid secretion would not be masked by an acid state which already existed. Blood samples were drawn for sugar determination simultaneously with many of the pouch samplings. Emptying of the pouch (and often blood sampling) was repeated at hourly intervals until the pH returned toward neutral, if there had been initial secretion of acid. Results are indicated in Table 1. Direct histamine analysis was employed on samples of the pancreatic tumor residue and dialysates, as well as the human liver residue and dialysate [*14*].

RESULTS

Table 1 records the results of this study. Administration of tumor dialysate A was followed by a change in pH from 7.2 to 1.72 (with a change in blood sugar from 81 to 92 mg. per 100 cc.). An initial test with this fraction had shown maintenance of an already acid secretion of pH 1.08 (with blood sugar values of 70 and 91 mg. per 100 cc.). The initial test was done before we realized the importance of awaiting a near neutral secretion before starting each test. This forty-eight–hour dialysis preparation showed pH changes from 8.3 to 7.5 when its residuum was administered. Thus, any secretory excitant present seemed to have been localized in the forty-eight–hour dialyzed fraction. In contrast, the twenty-four–hour dialysate of sample B showed changes from pH 7.0 to 4.3 and then 8.4 at hourly intervals (blood sugar: 70, 90 and 82 mg. per 100 cc.), with residuum B followed by changes in pH to 4.1, 1.6, 1.5 and 7.4 at hourly intervals (blood sugar: 72,__ , 74 and 77 mg. per 100 cc.). A second trial was made with the dialysate and then the residuum of sample B. There was essentially no change in the pH or blood sugar after giving the dialysate (pH 6.5 before and after, and blood sugar 72 and 71 mg. per 100 cc.). This was followed by a drop of the pH to 2.6 with recovery to 6.8 (blood sugar: 99 and 84 mg. per 100 cc.) after giving the residuum and making hourly observations. In these twenty-four–hour dialyzed samples, some excitant factor may have traversed the cellophane membrane; however, most of it did not and remained to be found in the supernatant solution of the residuum.

Changes in the pH of secretions from the pouches (and some blood sugar measurements)

TABLE 1

EFFECTS OF INTRAVENOUS EXTRACTS (DIALYZED AND RESIDUAL) ON HEIDENHAIN POUCH DOGS

Test No.	Experiment	Dog No.	pH and ( ) Blood Sugar (mg. %) Measurements — Hour							Comment
			0	1	2	3	4	5	6	
	Injections of tumor extracts:									
1....	Dialysate A (48 hr.), 20 cc.	2	1.1* (70)	1.1 (91)						Pouch secretion was not basal, near neutral
2....	Dialysate A (48 hr.), 25 cc.	2	7.2* (81)	1.7 (92)						
3....	Residuum A (48 hr.), 4.5 cc.	2	8.3* (81)	7.5 (81)						This sample comprised most of available residuum supernatant solution
4....	Dialysate B (24 hr.), 15 cc.	2	7.0* (70)	4.3 (90)	8.4 (82)					
5....	Dialysate B (24 hr.), 13 cc.	2	6.5* (72)	6.5 (71)						This test was followed by test 6
6....	Residuum B (24 hr.), 7.5 cc.	2	6.5* (71)	2.6 (99)	6.8 (84)					
7....	Residuum B (24 hr.), 7.5 cc.	2	4.1* (72)	1.6 ( )	1.5 (74)	7.4 (77)				Transient reaction (unsteadiness) after injection
	Injections of human tissue extracts:									
8....	Liver dialystate (36 hr.), 15 cc.	2	6.5*	7.0						
9....	Liver residuum (36 hr.), 10 cc.	2	7.0*	7.0						
10....	Pancreas dialystate (36 hr.), 100 cc.	1	7.6*	7.4						
11....	Pancreas dialystate (36 hr.), 100 cc.	1	7.6*	7.5						
12....	Pancreas residuum (36 hr.), 10 cc.	1	7.5* (98)	7.6 (113)						
	Fasting and feeding:									
13....	Prolonged fasting (18 hr.)	2	6.0	5.5	5.0 (75)	5.5	7.0	5.0	7.0	Followed by saline infusion (test 22)
14....	Feeding	1	3.6*	1.2						Pouch not in basal state
15....	Feeding	1	4.5	4.5*	1.1					
16....	Feeding	1	7.5	7.5*	1.2					
17....	Feeding	1	7.4	5.4*	1.3					
18....	Feeding	1	4.5*	1.3						
19....	Feeding	2	5.3* (82)	1.6 (72)						
20....	Feeding	2	6.5*	1.0						Test after prolonged fast (13) and saline infusion (22)
21....	Feeding plus saline infusion	1	4.5* (82)	1.1 (78)						Feeding was inadvertent

TABLE 1 (*Continued*)
EFFECTS OF INTRAVENOUS EXTRACTS (DIALYZED AND RESIDUAL) ON HEIDENHAIN POUCH DOGS

Test No.	Experiment	pH and ( ) Blood Sugar (mg. %) Measurements							Comment
		Dog No.	Hour						
			0	1	2	3	4	5	6	
	Injections of saline, histamine and glucagon:									
22....	Saline infusion, 250 cc.	2	7.0*	6.5						Followed prolonged fast (13), followed by feeding (20)
23....	Glucagon, 10 mg., intravenous	2	5.0* (67)	7.0 (209)						90 min. interval between samples
24....	Histamine diphosphate, 0.60 mg., subcutaneous	1	5.0*	1.3						
25....	Histamine diphosphate, 0.70 mg., subcutaneous	2	5.7* (96)	1.1 (90)						

* Times of injection or feeding.

were those which might have been predicted with striking acid production after feedings and episodes of subcutaneous administration of histamine. Little change occurred with prolonged fasting, intravenous administration of glucagon (although blood sugar rose from 67 to 209 mg. per 100 cc.), intravenous administration of saline, or the administration of dialysates and residuums of human liver and pancreas which had been employed for further control. On one occasion, a saline infusion was followed by a fall in pH from 4.5 to 1.1; this was explained by unauthorized feeding of the animal. Precautions were taken to preclude other such episodes.

Chemical analysis for histamine by the dinitrofluorobenzene method [*14*] demonstrated less than 0.5 μg. per gm. of residuum of both the control liver preparation and the pancreatic tumor sample B, and 2 and 5 μg. per cc., respectively, in their dialysates. These are only trace amounts of histamine which are far below concentrations which might stimulate gastric secretions in the experiment described.

An additional dog was given each new protein-containing substance (of tumor, liver and pancreatic origin) before the pouch dogs were tested so as to avoid any fatal reactions. No severe reactions occurred, although test dog 2 demonstrated a transient episode of unsteadiness during its final series of tests when the last injection of tumor residuum B was given. Dog 1 was used as a control animal when preliminary tests had been completed because of wound complications around his pouch stoma, anemia (which developed in both animals) and inanition. Release of tension of the fascia around the pouch stoma of dog 2 was performed under local anesthesia when it seemed necessary because of edema prior to the final tests.

COMMENTS

The data presented herein, which are necessarily limited by the small amount of tumor at our disposal, suggest that there may have been an excitant to gastric secretion in the samples of tumor. Further studies are needed to verify the existence and clarify the nature of the substance we have sought. If the present observations are confirmed, one may conclude that the principle is water-soluble, can traverse the cellophane membrane when dialyzed long enough against a sufficient volume of water (suggesting a molecular weight less than 25,000), resists postmortem autolysis to some extent and maintains activity despite long-term storage in a freezer. It did not resemble insulin or glucagon in our preparations (there was little

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change in blood sugar values), and similar effects were not observed in preparations made from human liver or pancreas. Direct chemical analysis showed only trace amounts of histamine. The effect upon the acid secretion from Heidenhain pouches of our dogs occurred after intravenous administration. A humoral effect was indicated, and this was both prompt and transient.

The endocrine inter-relation between pancreas and gastric secretion suggested by the reports of ulcerogenic, non-beta cell, pancreatic islet carcinoma leads one to recall early reports of multiple neoplasms of the endocrine glands and associated peptic ulcerations [*15–21*]. Adrenal cortical adenomas found in some of the patients with Zollinger-Ellison syndromes have led to speculation regarding some high level (pituitary) control [*8*]. In this connection, the adrenal corticoid relation to peptic ulceration and its clinical and experimental background have been cited [*22*]. The ultimate role of the inter-related endocrine systems in the genesis of any type of effect upon gastric secretion and peptic ulceration remains to be determined. In any event, it seems desirable to study the final, proximate mediation of effects upon gastric function. The ulcerogenic, non-beta cell pancreatic islet carcinoma of the Zollinger-Ellison syndrome may offer a unique opportunity for this, despite the difficulties of bio-assay.

CONCLUSIONS

An extract prepared from a small sample of a human, non-beta cell, pancreatic islet carcinoma stimulated acid secretion from a vagotomized, isolated, Heidenhain gastric pouch of a dog when given intravenously.

From the limited data available it appears that the substance: (1) resists prolonged freezing at ordinary freezer temperature; (2) tolerates postmortem autolysis to some extent; (3) is soluble in water and can pass through a cellophane membrane slowly when dialyzed; (4) quickly effects acid secretion from a Heidenhain pouch for a short time when given intravenously; (5) is not identical with histamine, glucagon or insulin; and (6) is not present in control preparations made from human liver and pancreas.

Further studies are needed to verify the existence of this substance (or substances) in ulcerogenic pancreatic tumors or in normal pancreas, and to establish its chemical and physiological characteristics.

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Problems Encountered in the Diagnosis and Treatment of Spontaneous Perforation of the Bowel in the Newborn

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SPONTANEOUS perforation of the bowel in the newborn is a true emergency. Early diagnosis and immediate treatment are imperative.

Reports of successful management of spontaneous perforation of the stomach and duodenum have become relatively common in the literature. The first case of successful treatment of this condition was reported by Leger and Ross in separate articles in 1950 [*1,2*]. Intestinal perforation distal to the duodenum has not been commonly reported but does occur [*3–5*]. Meconium peritonitis and its sequelae secondary to intrauterine perforation of the bowel has been described in detail by Tempest and Forshall in separate articles [*6,7*]. We will discuss some of the problems which have been encountered in the diagnosis and treatment of five babies with this condition. Spontaneous perforations occurred in all cases. Those perforations secondary to other causes have been eliminated.

ETIOLOGY

The etiology is obscure. Some of the commonly accepted theories include mechanical injury from gavage, congestion of the bowel musculature and mucosa (asphyxia or septicemia), trauma coincident with delivery, and high gastric acidity. Congenital defects of the bowel musculature, meconium stasis and diverticula have all been implicated. Administration of oxygen under pressure is another etiologic factor which has been implicated. Marked lymphoid hyperplasia with resulting perforation has also been suggested as an etiology [*1–4,6,7,9,10–19*].

None of the etiologic factors commonly outlined in the literature offer an adequate explanation of this condition. Mechanical injuries such as gavage and trauma can only rarely be incriminated. Asphyxia, septicemia, vascular insult and congenital defects have not been demonstrated in the majority of the cases.

We have seen spontaneous perforations occurring from the stomach to the colon with no consistent pathologic disorder to explain them. In the five cases presented herein, only one perforation was found in the stomach. One was in the distal jejunum and one in the descending colon. In two cases, perforation was not noted either at surgery or at autopsy, although free air was found on roentgenographic examination.

CASE 1. Baby boy S., who died at birth, demonstrated perforation of the descending colon which had occurred *in utero*. His mother was a diabetic who had trouble controlling her diabetes during pregnancy. The child was very large at birth, weighing over 10 pounds, and considerable difficulty was experienced in delivery of the shoulders. Immediately postpartum the child took several breaths and became cyanotic. He died within a few minutes of delivery in spite of the usual resuscitative measures. Autopsy demonstrated bilateral atelectasis of the lungs. The cardiorespiratory system was normal. On opening the abdomen, subacute peritonitis was seen. The liver and spleen were congested. The small and large bowel was threaded throughout its length, and no atresia or obstruction was seen. The anus was perforate. Ten centimeters from the ileocecal valve on the wall of the ileum there was a fibrinous mass 2.5 cm. across showing granulation tissue,

inflammatory exudate and yellow-green meconium. This was adherent to a 1 cm. perforation of the descending colon 4 cm. from the splenic flexure. A considerable amount of meconium and inflammatory exudate filled the pelvis. Several loops of small bowel were involved in the adhesive exudate. Analysis of the meconium showed a normal amylase level. Microscopic examination showed a localized chronic inflammatory process.

When spontaneous perforation of the bowel takes place before birth, the contents are sterile and the activity of the alimentary canal is minimal. Generalized bacterial peritonitis does not occur. Plastic non-infective peritonitis results, with formation of fibrous tissue which may later become calcified. The extent of the plastic reaction is variable and may result in the formation of adhesions [*6,7*]. Partial or complete obliteration with obstruction can occur. In postnatal perforations, infective material is spilled into the peritoneal cavity which is no longer sterile. A secondary bacterial infection rapidly intervenes. Unless this perforation is closed, ileus, toxemia and death occur before localization can take place [*4*].

A relatively uniform clinical picture leads to the diagnosis of spontaneous perforation of the bowel in the newborn. The infant may be delivered normally and may remain well for a few hours to a few days. Feedings are refused. Cyanosis, circumoral pallor and dyspnea develop. Vomiting of bile-stained material may occur. Considerable abdominal distention is also observed. Bowel sounds may be absent and the abdomen tympanitic. The muscular rigidity which is seen in older patients is absent. Dyspnea and cyanosis may be so prominent that the diagnosis of respiratory disease is often made initially. One patient in this series was incorrectly diagnosed and treated for a respiratory problem.

CASE II. Baby boy G., who was the product of premature labor, was born on December 6, 1958. Birth weight was 2 pounds. Crown to heel length was 13 inches. The patient had labored, grunting respiration immediately postpartum but improved with nasotracheal suction.

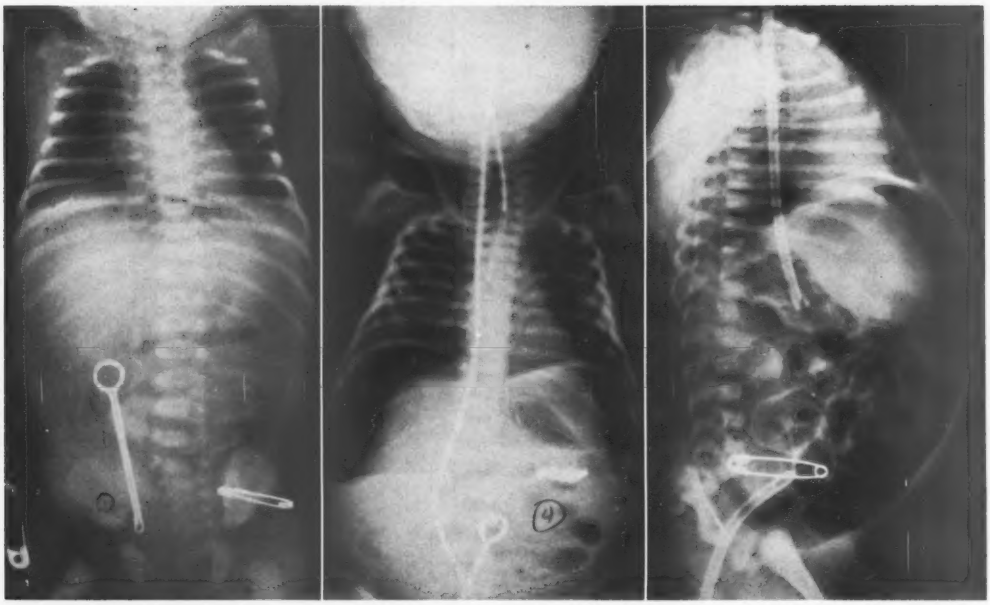
Physical examination showed well expanded lungs with no apparent abnormalities, except for a bilateral extra digit at the base of the fifth phalanx. Gastric feedings were started on the second day of life. At that time the child had good respirations and was in no apparent distress. The patient passed normal meconium stools and voided spontaneously. On the third hospital day, a slight jaundice was noted and periods of apnea began to develop. The patient continued to pass normal meconium stools. The periods of apnea became more pronounced, and the child became more lethargic. There was no regurgitation until one day before his death. On the seventh hospital day the apnea and respiratory distress became very frequent, with distention of the abdomen. The patient died on the seventh hospital day with what was believed to be a respiratory ailment. Autopsy showed hemorrhagic atelectasis with aspiration bronchial pneumonia in the lungs. On opening the abdomen, peritonitis was immediately manifest. A cloudy, blood-tinged fluid was present. The stomach was intact and showed no areas of perforation or ulceration. There was a moderate distention of the large and small bowel throughout its length with no evidence of atresia or obstruction, and the rectum was normal. A perforation of the small bowel at the distal jejunum was seen. The perforation was 1 cm. in length and parallel to the bowel on the antimesenteric border. It was adherent to the mid-portion of the transverse colon by recent granulation tissue. Culture of the exudate around the perforation showed coliform bacillus, staphylococcus and streptococcus.

LABORATORY DATA

The diagnosis of this condition is not aided by a leukocyte count. It can be made from the flat plate of the abdomen which reveals a pneumoperitoneum in the majority of cases. Repeated roentgenograms of the abdomen should be taken when free air is not found on the original film. Figure 1 shows the flat plate of an abdomen taken twenty hours after delivery of a child whose bowel had perforated. Symptoms of an intra-abdominal catastrophe developed. A generalized haziness was noted on the first film but no free air was seen. Figure 2 represents a film taken two and a half hours later, which reveals a pneumoperitoneum.

Intraperitoneal air may elevate the diaphragm and cause marked respiratory distress. Figure 3 illustrates the marked elevation of the diaphragm due to free intraperitoneal air. This child had considerable respiratory improvement upon removal of the air. The pneumoperitoneum was under pressure and air escaped from the abdomen with a hissing sound. Abdominal paracentesis may facilitate respirations before surgery. Respiratory difficulty associated with this disease demands local infiltration of the operative site and a minimal general anesthesia.

In our one successful case (Case III), surgical



1 2 3

FIG. 1. X-ray film of abdomen; no pneumoperitoneum is seen.

FIG. 2. X-ray film of abdomen taken two and a half hours later; an obvious pneumoperitoneum is present.

FIG. 3. Marked elevation of diaphragm and respiratory distress due to free intraperitoneal air.

FIG. 4. Case III. X-ray film of abdomen.

FIG. 5. Case IV. Pneumoperitoneum is present but no perforation could be found.

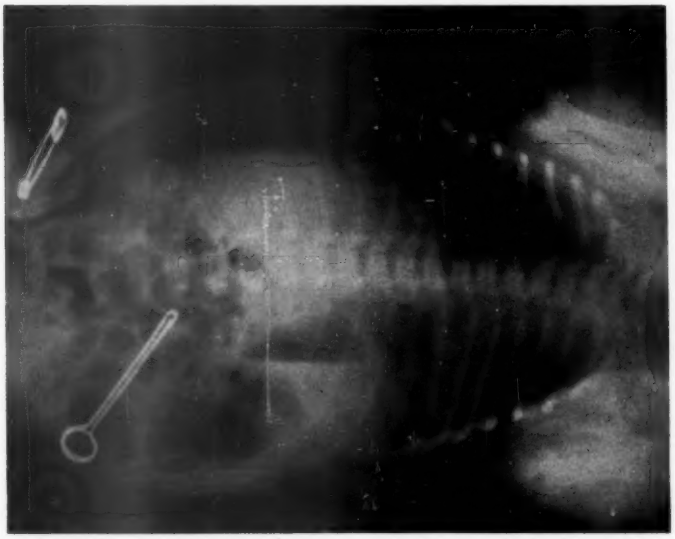


FIG. 6. Case v. Decubitus film showing pneumoperitoneum but no perforation could be found.

exploration was performed within the first twenty-four hours after onset of the symptoms. All the clinical manifestations outlined were present in this patient. Figure 4 represents the pneumoperitoneum demonstrated on the roentgenogram. At surgery a 2.5 cm. laceration was found on the greater curvature of the stomach, extending into the gastrocolic omentum. The laceration was repaired, and the patient made an uneventful recovery. No definite cause of this laceration could be determined.

Early surgery as soon as a definitive diagnosis can be made is the only hope for survival of these infants. Only one perforation was found in the stomach among the patients discussed herein. If the perforations occur beyond the duodenum, nasogastric suction is of little value. It is impossible to determine the exact location of the perforation without surgical intervention.

The last two patients (Cases IV and V) had signs and symptoms of perforation of the bowel. The x-ray films demonstrated a pneumoperitoneum in both patients. They were operated on at the optimum time, within the first twenty-four hours after the onset of symptoms. In neither case could a perforation be demonstrated. Diffuse peritonitis was seen, but the perforation could not be found after thorough exploration. Evidently a minute perforation had occurred and subsequently sealed. Death occurred within a few hours after surgery, and no perforation could be seen at autopsy. Figure 5 shows a flat plate of the abdomen of the first baby who presented all the clinical signs of perforation. Pneumoperitoneum is present but no perforation could be found either at surgery or autopsy. Figure 6 represents a flat plate of the abdomen showing a pneumoperitoneum in which, again, no perforation could be found at surgery or at autopsy.

Failure to find the perforation after typical clinical findings and pneumoperitoneum have been demonstrated has not been previously reported. Since it is impossible to tell preoperatively whether the perforation has closed, surgical exploration is mandatory. If perforation is not found after an adequate search, the abdomen should be closed and unnecessary manipulation of the bowel avoided.

SUMMARY

Five cases of spontaneous perforation of the intestinal tract in the newborn are presented. These occurred in the stomach, the small bowel and the large bowel. Two perforations could not be demonstrated at surgery or at autopsy, despite clinical evidence indicating perforation. The etiology of this condition is obscure, and none of the etiologic factors proposed in the literature adequately explain the condition.

The sequence of clinical symptoms which consist of refusal to eat, emesis, cyanosis and distention, followed by a roentgenographic demonstration of pneumoperitoneum, are outlined. If the condition is suspected by the clinical picture, but pneumoperitoneum is not demonstrated on roentgenograms, additional x-ray films of the abdomen should be obtained. These patients should be operated upon as soon as a diagnosis is made. A preoperative paracentesis to remove free air in the abdomen will often give considerable respiratory relief. If the surgeon is unable to demonstrate the site of perforation after thorough exploration, he should realize that it can seal spontaneously. The abdomen should be closed without further manipulation of the bowel.

Spontaneous perforation of the bowel in the newborn is an acute emergency. Early diagnosis and immediate treatment may result in a dramatic surgical triumph.

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Duplications of the Stomach

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TRUE duplications of the stomach are rare. They have been called accessory stomachs, enteric cysts and enterogenous cysts. Duplications of the stomach are hollow, and they have a muscular coat usually consisting of two layers, a lining of gastric epithelium and an intimate attachment to the stomach. Wendell [1] reported a successful excision of an "accessory stomach" in 1911. Others [2–10] have also reported simple excisions of gastric duplications. Owen [11] described a primary partial excision of a gastric duplication with anastomosis of the remainder of the cyst to the cardia of the stomach. He did this because he found that a complete excision was not feasible. Berg [12], Lyall [13], Mayo [14], McNeer [15], Miller [16] and Shaw [17] have reported the resection of the duplication together with that part of the stomach attached to the duplication. However, when the cysts are very large, the amount of stomach that must be resected in order to remove the duplication is so large as to make the procedure unduly hazardous and undesirable. In such cases destruction of the mucosa of the cyst coupled with external drainage or marsupialization has been practiced by Barbosa [18], Cabot [19], Ferraro [20], Krahann [21], Ladd [22] and Nolan [23]. The rate of effectiveness of this procedure is low. In the six reported cases in which it has been used, it cured the duplication only twice [18,22]. The other four patients [19,20,21,23] required another operation, namely, excision of the cyst in three [19,20,23] and an anastomosis between the wall of the duplication and the cardia of the stomach in one [21].

Four patients with gastric duplications were treated in the Barnes and St. Louis Children's Hospitals between 1951 and 1958. Intrathoracic cysts were not included in this review.

CASE REPORTS

CASE I. M. B., a four month old baby girl, had had a "feeding problem" since birth. She was unlike her identical twin sister in that she could not take nearly as much formula and failed to gain weight. Three weeks before she was admitted to the St. Louis Children's Hospital she began crying after each feeding as if she had abdominal pain. Just before being brought to the hospital her feces was noted to be dark brown. She had been febrile for three days, and her temperature once reached 41°c.

A spherical mass about 4 cm. in diameter was easily felt in the left upper quadrant of the abdomen. Her hemoglobin was 7.7 gm. per cent, the white blood count was 20,850 per cu. mm., and the fecal guaiac reaction was positive. The radiographic examination demonstrated the existence of an extramucosal mass which produced a filling defect in the region of the pars media and antrum of the stomach. The gastric mucosal pattern of the displaced part of the stomach was irregular, suggesting mucosal ulceration. The radiologist thought these signs were compatible with a leiomyoma or a duplication of the stomach.

During celiotomy, a cystic mass adherent to the greater curvature and posterior aspect of the stomach was found. (Fig. 1.) This mass was incorporated within the gastrocolic omentum and the transverse mesocolon. Upon looking into the interior of the stomach through a gastrostomy, the mucosa overlying the part of the stomach covered by the cyst was seen to be edematous. This mucosa bore no rugal folds, and petechiae covered it. The cyst was excised, leaving an externally denuded gastric wall. The lesser omental sac was drained.

Histologically, the wall of the duplication was comprised of two layers of smooth muscle. Granulation tissue lined the cyst, and it contained no gastric epithelium. Four years have passed since the duplication was excised, and the child has not had any trouble. Her identical twin has been examined, and no gastric abnormality was discovered.

CASE II. R. P., a Negro baby girl, was eight months old when she was brought to the St. Louis Children's Hospital because of "respiratory diffi-

FIG. 1. Case I. Location of duplication.

FIG. 2. Case II. Location of duplication.

culties" and fever. She was known to have had a microcytic hypochromic anemia which had responded poorly to treatment with iron. She had eaten well ever since birth and had suffered little with colic. The child was pale and breathing laboriously. The respiratory motions of her left hemithorax were restricted, and the anterior upper aspect of the left side of the chest was dull to percussion. The intensity of the breath sounds was subnormal over the entire left hemithorax. Three thoracenteses were performed on the left side and only small amounts of sterile fluid containing no tumor cells were obtained. Her hemoglobin was 7.6 gm. per cent, hematocrit was 23 per cent, reticulocyte count was 5.7 per cent, and the white blood count was 10,600 per cu. mm. Roentgenographic examination of the chest, and of the upper gastrointestinal tract following a barium meal, showed a displacement of the mediastinum toward the right. The left hemithorax was almost completely radiopaque. During a fluoroscopic examination of the thorax the left hemidiaphragm was found to be immobile, and a filling defect was seen in the pars media of the stomach on the greater curvature. Because of the seeming existence of a mass in the upper mediastinum, exploratory left thoracotomy was performed. A large amount of gelatinous material was found in the left pleural cavity and an exudate covered the entire surface of the left lung. The left pleural cavity was found to communicate with the abdominal cavity through a defect in the left hemidiaphragm in the region of the cardiophrenic angle anteriorly. (Fig. 2.) The lesser omental cavity and the peritoneal cavity above the transverse colon contained the same gelatinous material and exudate found in the left pleural space. A cystic mass, 2.5 cm. in diameter, was found attached to the pars media on the greater curvature. This cyst did not communicate with the stomach or the peritoneal cavity. There was no evidence indicative of perforation of the cyst. The remainder of the gastrointestinal tract was normal. Decortication of the left lung was performed, and the duplication of the stomach was excised together with the adjacent gastric wall. A water-sealed drainage of the left pleural cavity was instituted. Microscopically, the cyst was a typical gastric duplication—a three-layered, smooth-muscled wall, a recognizable muscularis mucosa and a gastric mucosal lining. Heterotopic pancreatic tissue was found in part of the wall of the duplication. At the time of writing, six months have passed since this child was operated upon and she has been well.

CASE III. D. D., a five years old girl, had been well until cramping abdominal pain and vomiting began to trouble her a short time before she was seen at the Children's Clinic. The pain occurred two or three times daily and was unrelated to the ingestion of food. Three days before the pain and vomiting began, she had fallen upon her back from a trapeze. She appeared to be acutely ill, and was lethargic and dehydrated. Tenderness and voluntary muscle spasm in the right upper quadrant of the abdomen, and a tender, 3 cm. epigastric mass which moved with respiration were found. Blood and urine studies disclosed no abnormalities. The

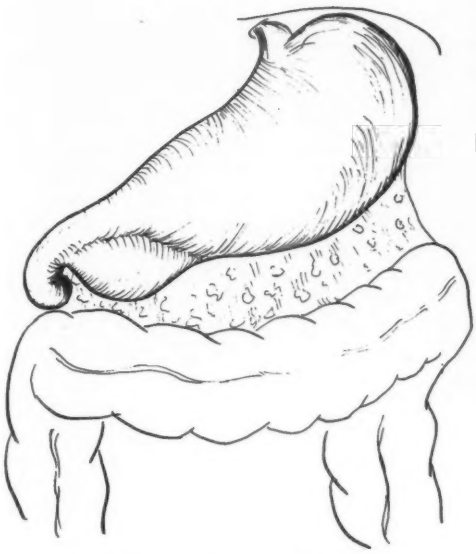

FIG. 3. Case III. Location of duplication.

mass was presumed to be a cyst preoperatively, and this diagnosis was proved at surgery. It was firmly adherent to the prepyloric region of the stomach and it so impinged upon the lumen of the pylorus as to partially obstruct it. (Fig. 3.) About 5 ml. of brown fluid escaped from it when it was opened. No communication between the cyst and the stomach could be found. A retroduodenal hematoma was evacuated and, because the patient's condition was poor, only anterior gastrojejunostomy was performed. Five months later she was admitted to the hospital again because of abdominal cramps. The abdominal mass was palpable again. This time the duplication and the part of the stomach bearing it were removed and gastroduodenostomy was performed.

Microscopic examination of the cyst proved it to be a gastric duplication. It was lined with gastric mucosa and its wall contained two layers of smooth muscle. Heterotopic pancreatic tissue was found in a part of the wall of the duplication. Seven years have since passed and the child is well.

CASE IV. M. S., a two month old girl, had gained very little weight since her birth and had vomited postprandially for a month. She was cachectic. A mass, 3 by 10 cm. in size, was felt in the left upper quadrant of the abdomen. Her hemoglobin was 8.4 gm. per cent, the white blood count was 10,100 per cu. mm. and the non-protein nitrogen was 75 mg. per cent. A complete radiographic examination of the upper gastrointestinal tract demonstrated three spherical and ovoid

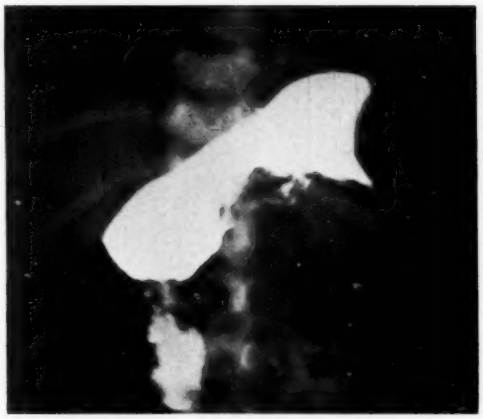

FIG. 4. Case IV. Preoperative roentgenographic examination of stomach. Three filling defects are visible along greater curvature.

impressions along the greater curvature and posterior wall of the stomach (Fig. 4), and the radiologist made an unequivocal diagnosis of gastric duplication preoperatively. Actually, three separate duplications were found attached along the greater curvature of the stomach. (Fig. 5.) A gastrotomy was made through a normal part of the stomach. There was no evidence of communication between cysts or between the lumen of the stomach and the

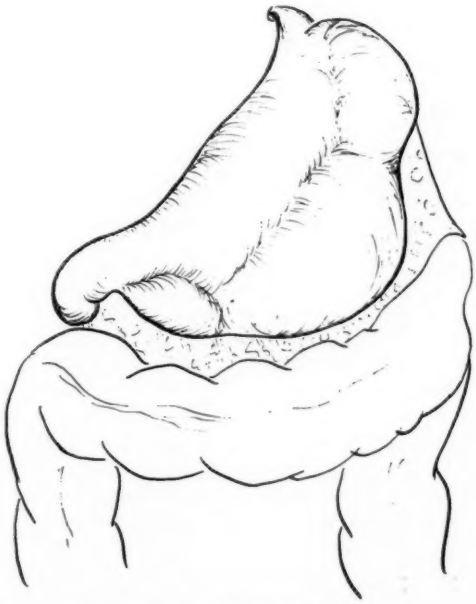

FIG. 5. Case IV. Location of duplications.

FIG. 6. Case IV. Roentgenographic examination of stomach one year after septa between stomach and duplications were excised.

lumens of the duplications. Upon opening through the common walls of the cysts and the stomach, the cysts were found to be lined with normal mucosa which had the appearance of that of the stomach. Since the duplications could not be separated from the wall of the stomach (and resection of the stomach with the cysts could not be performed because their size and extent were such as to require the removal of practically all the stomach), the parts of the walls of the cysts separating the cavities of the cysts from the lumen of the stomach were completely excised, and the rims of the openings so produced were sewn with a continuous suture of chromic catgut to secure hemostasis. This procedure merely effected free communication between the cysts and the lumen of the stomach. The patient's postoperative course was uncomplicated. X-ray films of the stomach taken a year after this operation demonstrated "only slight residual deformity along the greater curvature." (Fig. 6.) The child has been well for twenty months.

COMMENTS

The symptoms common to most patients with gastric duplications are vomiting, intolerance of feeding, failure to gain weight, intermittent abdominal pain, and (infrequently) melena and hematemesis. A mass can often be palpated in the upper quadrants of the abdomen. An extramucosal mass, bulging into the lumen of the barium-filled stomach, is readily demonstrable radiographically. Excision of the duplication, together with the part of the stomach wall to which it adheres, is the simplest treatment for all except very large or multiple duplications. Very large duplications may be treated by excising the septum between the duplication and the stomach, converting the separate cavities into one. Our experience is peculiar in that gastric duplication is not a very rare entity in St. Louis, four cases having been seen here during seven years. My references list all the reported cases (twenty-three) of intra-abdominal gastrogastric duplications that could be found.

SUMMARY

The simplest treatment of gastric duplications is excision of the cyst together with the part of the stomach to which it is attached. In very large or multiple duplications, the septum between the cyst and the stomach may be excised, thereby converting the separate cysts and gastric cavities into one.

Twenty-three previously reported cases of gastric duplications are reviewed. Four patients with gastric duplications who were treated at St. Louis Children's and Barnes Hospitals between 1951 and 1958 are described.

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Measurement of Cardiac Output in Dogs During Cardiac Massage

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Cardiac massage alone or in conjunction with other procedures has become a recognized and apparently worthwhile procedure in treating cardiac arrest [*5,6,12*]. Briefly, the conditions that must be met for successful reestablishment of the heart beat are positive pressure ventilation and manual massage of the heart. The technics of massage employ either single or bimanual mechanical compression and relaxation of the heart at various rates.

A number of authors have inferred that if cardiac massage is initiated soon after cessation of the heart beat, the metabolic requirement of the brain and other vital organs will be sustained, regardless of the duration of manual circulation [*1,6*]. This inference is apparently based on the assumption that manual massage yields cardiac outputs of sufficient volume to preserve the vital organs.

The purpose of this project was to ascertain the cardiac outputs during heart massage by direct measurement at various rates and output resistances.

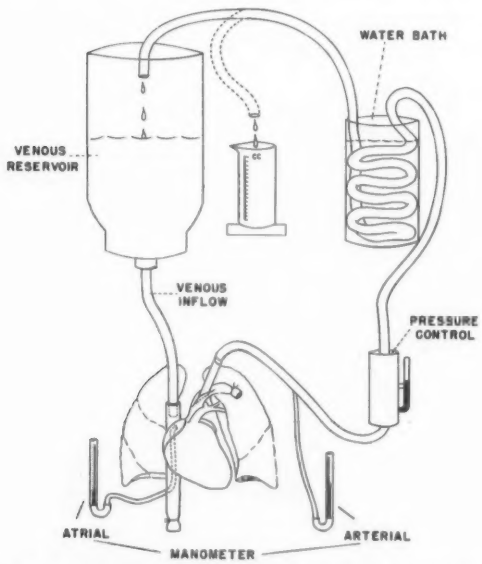

Fig. 1. Diagrammatic scheme of Starling heart-lung preparation used in this study.

METHOD

Five mongrel dogs weighing 8.2 to 11.8 kg. were anesthetized with sodium pentobarbital (Nembutal,® 60 mg./cc.), 0.5 cc./kg. intravenously. Starling heart-lung preparations (Fig. 1) were made on each of the experimental animals and these were ventilated with oxygen. These preparations have completely extracorporeal circulation with the exception of the lungs in which the circulation remains undisturbed.

The artificial peripheral resistance device was constructed with a large diameter Penrose rubber tube (approximately 3 inches in length) which was sealed within a tubular glass chamber. Resistance to flow was produced by increasing the air pressure in the glass container surrounding the collapsible rubber tubing which was part of the outflow circuit. This air pressure or resistance to flow, was measured in millimeters of mercury.

The mean arterial blood pressure was measured by a mercury manometer attached directly to the outflow tubing. The right atrial pressure was measured by insertion of a polyethylene catheter into the right atrium via the inferior vena cava.

The venous inflow reservoir was so positioned that at peripheral resistances of 75 and 100 mm. Hg, the total inflow was maintained at 80 cc./kg. of body weight per minute; this inflow

volume was kept constant throughout the experiment. The temperature of the blood reaching the superior vena cava ranged from 33° to 36°c. Heart rates under control conditions ranged from 88 to 148, but were essentially constant for each animal. The cardiac output was measured by timed collection directly into a graduate cylinder.

After establishing cardiac outputs of approximately 80 cc./kg./min. under the aforementioned control conditions with the pericardium opened, the hearts were electrically fibrillated. Massage outputs were then determined. We used the same filling head of pressure as in the control determinations.

Manual systole was performed with single-handed and bimanual massage at rates of 40, 60, 80 and 100 compressions per minute and at peripheral resistances of 55, 75 and 100 mm. Hg. Although all the outputs noted in the experimental results were produced by one of us (S. A. H.), a number of observers who also massaged obtained similar results.

In each experiment, the coronary arteries were ligated near the ostia after data were obtained on the fibrillating but otherwise intact heart. The massage procedures were repeated at rates of 40 and 60 compressions per minute and at peripheral resistances of 75 to 100 mm. Hg.

At the conclusion of each experiment, the heart was removed and weighed.

RESULTS

Cardiac outputs obtained under control and experimental conditions are summarized in Table 1.

Average cardiac outputs at peripheral resistance levels of 55, 75 and 100 mm. Hg ranged from 16.5 to 37 per cent (average, 26 per cent) of the control values.

There appears to be no correlation of cardiac outputs to the various values of peripheral resistances employed, because blood pressure remains relatively constant under both control and experimental conditions.

The optimal rate of manual systole is between 60 and 80 compressions per minute. The cardiac output during massage is essentially unaffected by ligation of the coronaries.

COMMENTS

The effectiveness of cardiac massage in terms of output is based upon the establishment of a proper relationship between output during massage and output in the resting state in the intact animal. Various methods have been used to show that the cardiac output in dogs during Nembutal anesthesia is approximately 160 cc./kg./min. [9,10].

Johnson and Kirby [7] have reported on cardiac output during massage; they used a bubble flow meter placed in the thoracic aorta and in the common carotid artery. Their findings indicate that the output with massage can equal 50 per cent or more of the values which they used as controls. The output values obtained by Johnson and Kirby may be deceptive since the control values used in their experiments were about one-fourth the accepted cardiac output values established by dye-dilution technics in intact dogs. Their low control values may well be due to the fact that their output measurements were obtained in dogs with open chests. This factor alone is known to diminish the cardiac output markedly [4,8]. When these cardiac massage output values and those obtained in this work are related to the expected output values for intact dogs, one obtains a massage output of 13 per cent as compared to 12 per cent obtained in the present investigation.

Cardiac output in man has been established

TABLE 1

CARDIAC OUTPUT (CC./MIN.) MAINTAINED BY MANUAL COMPRESSION RATES OF 60 TO 80 PER MINUTE

Peripheral Resistance (mm. Hg)	Dog 1, 9.5 kg.	Dog 2, 11.8 kg.	Dog 3, 9.5 kg.	Dog 4, 9.5 kg.	Dog 5, 8.2 kg.
55	190	342	200	318	159
	155	504	120	342	156
	140	492	180	216	135
	.....	252	108	300	152
	.....	306	76	270	160
	.....	276	152	298	192
75	100	318	96	150	180
	100	300	76	330	126
	80	192	60	255	144
	190	246	142	330	200
	130	372	96	354	164
	130	258	144	402	180
100	130	219	156	234	120
	140	261	168	213	159
	140	312	156	144	165
	170	186	.....	252	232
	200	237	.....	390	212
	160	228	.....	348	176
Average massage outputs.....	143	295	128	285	166
Control based on 80 cc./kg./min....	760	944	760	760	656
Per cent of control..	18.5	31	16.5	37	25

at approximately 80 cc./kg./min. It is slightly increased in children [2,3]. In a sense, the control output values (80 cc./kg./min.) in dogs used throughout this work may be said to approximate the values for a man of proportional weight.

The heart-lung preparation not only enables the regulation of the diastolic inflow, thus the cardiac output, but also permits the direct and immediate measurement of the latter. However, the artificial pressure control unit (called "peripheral resistance" by Starling) ensures the maintenance of the predetermined pressure. In this way the situation differs from that in the patient with cardiac arrest. We may assume that peripheral resistance in cardiac arrest varies in response to changes in pressure in the vasosensory zones and the degree and duration of ischemia of the medulla. Thus, in the patient with diminished cardiac output, widespread peripheral compensatory vasoconstriction might diminish the fall of arterial pressure. This would preserve, to some extent, the cerebral blood supply even with low cardiac output. With more prolonged and severe medullary ischemia, one might expect a failure of vasomotor tone. In such a case even a "normal" cardiac output might well be insufficient to maintain a satisfactory cerebral blood flow, since it is commonly believed that the cerebral blood vessels have less capacity for dilatation than the circulation as a whole.

The optimal rate of cardiac massage is approximately 60 compressions per minute; decreasing this rate to 40 markedly decreases the output, while increasing the rate over 80 results in no appreciable increase in output. Indeed, compression rates of 80 and above rapidly lead to fatigue in the operator and subsequently to decreased outputs.

Heart-lung preparations permit the manipulation of the peripheral resistance and thereby the arterial pressure. During the course of the present experiments, adjustments of the peripheral resistance from 55 mm. Hg to 100 mm. Hg were made. Elevation of the peripheral resistance resulted in a concomitant rise in the blood pressure as would be expected. However, the volume of the cardiac output is not a direct function of the blood pressure produced at any level of peripheral resistance. That is to say, at the highest arterial pressure achieved (120 mm. Hg), massage outputs did not exceed 30 per cent of the control values. Thus, measurement of the arterial pressure in the heart-lung is an inadequate index of the sufficiency of manual systole.

After eight to ten manual compressions, the color of the myocardium was observed to improve markedly, changing from a deep blue to pink. This suggests that a somewhat adequate coronary perfusion occurs during manual systole. However, exclusion of the coronary circulation by ligation of the coronary arteries at their ostia does not increase the output during massage. Thus, only a small fraction of cardiac output contributes to coronary perfusion during massage.

In this investigation only 26 per cent of normal cardiac output was obtained by massage. If massage provides a similarly diminished cardiac output in the patient with cardiac arrest, it would seem advisable to exclude all arterial circulation except to the heart and brain in order to provide maximal blood flow to these vital areas.

Application of an atraumatic clamp to the thoracic aorta (as suggested by Wiggers [11] and Johnson and Kirby [7]) and occlusion of the arterial supply of the upper extremities by arterial tourniquets should increase the available blood supply to the most vital areas.

SUMMARY

1. Direct measurement of the cardiac output during massage was made using Starling heart-lung preparations.

2. Control output values of 80 cc./kg./min. were established. This is the expected value for adult humans. Massage values averaging 21 cc./kg./min. (or 26 per cent of the expected cardiac output in humans) were obtained.

3. The optimal rate of massage in terms of output is 60 compressions per minute.

4. Coronary flow during cardiac massage is apparently small, since the exclusion of the coronary circulation by ligation of the coronary arteries at their ostia does not increase the output during massage.

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Local Care of Burns

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It has been stated that bacteremia still accounts for the majority of deaths following extensive burns [1]. Therefore, the main objective in the treatment of burns, after control of the shock phase, is to keep infection to a minimum until successful skin grafting can be performed. Since 1952 I have supervised the treatment of all burns in a large city hospital in San Antonio with this goal in mind.

We know that infection is always present in any open wound, and we use every available means to keep that infection to a minimum. Although we utilize penicillin and streptomycin routinely for forty-eight hours following the burn, we do not use antibiotics after this time unless they are specifically indicated or until surgical procedures are performed. We believe that routine prophylactic use of antibiotics destroys innocuous bacteria, and that they interfere with the production of antibiodies in the host. This allows drug-resistant organisms to flourish. We pay close attention to the resistance of the host and give meticulous local care to the burn. Host resistance is enhanced by a high vitamin, high caloric intake. The patient is given frequent feedings of palatable foods. Local treatment of the burn includes not only measures to discourage bacterial invasion but also measures to minimize the introduction of infection. Sterile bed linens are the rule until grafts are applied. Caps, masks and gowns are worn when attending the patient, and sterile gloves are used when caring for the burn. Except for the hands, we employ the open method of treatment in deep second and third degree burns. We have observed that pseudomonas infections invariably develop in deep burns at the fifth to the seventh day when closed treatment is employed. Other than placing the patient on sterile linens, no local treatment of the burn is undertaken until all phases of shock treatment are well underway [3]. We then gently wash all the burned area with pHisoHex,® rinse it with saline, debride ruptured blisters, and leave a thin film of pHisoHex on the surface of the burns [4]. Intravenous Demerol® is adequate sedation for this purpose. We never give a general anesthetic before cleansing the burn. The sterile bed linens should be changed several times a day as long as there is extensive weeping from the surface of the burn. We attempt to expose all the burned surfaces to the air so that a protective crust may form. If this is not possible due to the wide extent of the burn, we leave the patient on his back for forty-eight to sixty hours which allows a crust or eschar to form anteriorly. Lung expansion is much better in this position during the critical phase of shock. The patient may then be placed in the prone position for long intervals to allow a crust to form on his back. Stryker frames are of great benefit at this stage. We believe that a crust or eschar over the burn effectively encases bacteria on the surface of the burn, and serious trouble from local infection should not be anticipated until the eschar starts loosening or cracking on the twelfth to seventeenth day.

Daily attention is given the burn and the surrounding skin. The skin surrounding the burn is washed rather vigorously with pHisoHex solution twice daily, and the burn itself is washed gently with pHisoHex followed by a gentle application of saline solution daily. This leaves a small, invisible film of pHisoHex on the surface of the burn. This treatment is continued until grafting is done. When the eschar

has been debrided, this treatment is continued on the granulating surface. It is generally conceded that the raw, granulating areas should be kept covered when the eschar starts cracking, but the methods of so doing and the treatment thereafter have many variants. We formerly kept our patients in an occlusive dressing which was kept wet with solutions, and took the patient to the operating room every few days for debridement procedures. This was not satisfactory for several reasons. During the interval between change of dressings we could not observe the wound. Therefore, granulating areas could become infected and not receive immediate treatment, and pus pockets that should have immediate drainage could develop under the eschar and remain undetected for several days. An anesthetic would have to be employed for each debridement procedure, necessitating a very low caloric intake on the day of surgery.

When the burn eschar begins to crack, generally between the twelfth and seventeenth day, we merely debride what is loose and place one layer of fine mesh nitrofurazone-medicated gauze over the granulating surface. This gauze should be changed at least once daily. Gauze medicated with nitrofurazone (Furacin®) is water-soluble and does not permit the accumulation of pus [5]. It is inexpensive and bacterial resistance does not develop readily. The incidence of allergic reactions is very low. When they do occur they immediately disappear with the discontinuance of this product [2,6]. The eschar is observed daily for any fluctuant areas and if any are found, they are opened. If pus is present, the entire area is debrided to the extent of the undermining. The pus is cultured and bacterial sensitivity tests are made.

Between the seventeenth and the twentieth day we follow one of two courses of debridement and grafting procedures, according to the extent and severity of the burn and the condition and age of the patient. If the patient is young, the burn is not too extensive and the burn wound is relatively clean, we may elect to debride with the patient under a general anesthetic, with hopes of grafting a few days later. If this procedure is followed, we routinely give the adult patient 10 million units of penicillin (the child is given 5 million units of penicillin) the day of debridement and routinely administer a broad-spectrum antibiotic thereafter. This is done because it has been our observation that fatal septicemia may develop following this procedure. With this regimen, we place a single layer of fine mesh gauze over the granulating surface following debridement, and wet this each hour with a solution of benzalkonium chloride U.S.P. (Zephiran® 1:5000 and acetic acid 0.25 per cent). This dries in about twenty minutes, and we believe that the alternate drying and wetting with a mildly germicidal acid solution discourages bacterial growth. This dressing is changed once daily and the treatment is continued until the time of grafting. On the other hand, if the patient's burn is extensive or if he is aged or debilitated, we elect to follow a more conservative procedure, such as daily debridement of that crust which is loose and can be excised without bleeding. This is done at the time the dressing is changed each day. The patient is given intravenous or intramuscular Demerol for sedation. It allows the patient to eat well every day without the interference of a general anesthetic. With this type of treatment, the patient is usually completely debrided and ready for grafting between the thirty-fifth and fortieth day. During this interval antibiotics are prescribed when indicated. When surface infection is evident (by any purulent exudate on the granulating surface), one layer of fine mesh gauze is used to cover the granulating surface and the solution of Zephiran and acetic acid mentioned previously is employed each hour to wet the gauze. When the nerve endings have not been entirely destroyed in deep second degree burns, changes of the dressing with fine mesh gauze are extremely painful. We have recently continued the use of the Furacin gauze with the wetting agent described. This makes the changes of the dressing less painful. Then pHisoHex is utilized on the surface of the burn and on the skin surrounding the burn. Four or five days prior to grafting, all prospective donor sites are washed twice daily with the antiseptic detergent solution. At the time of grafting, as much as possible of the granulating surface is covered, provided the patient's condition permits, since this is the golden opportunity for successful grafting. This results in a greatly shortened period of hospitalization and disability. Furacin gauze is placed over the grafts and a pressure dressing is applied when it is indicated. One layer of fine mesh gauze is placed over the donor areas after the graft has been taken. Additional packs are placed over

the fine mesh gauze to absorb the blood. The packs are removed the following day, leaving one layer of fine mesh gauze dressing over the donor sites.

SUMMARY

Bacteremia is still a major cause of death following extensive burns. When it occurs, it is usually due to an organism which is sensitive to only a few select antibiotics which are dangerous themselves. To prevent this complication and to circumvent surface infection which may greatly impair the successful take of skin grafts, I have reviewed my cautious approach to the use of antibiotics, promotion of host resistance and meticulous care of the burn.

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Lye Stricture of the Esophagus: Esophageal Replacement Using the Right and Transverse Colon

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A PERSON who cannot swallow is a miserable creature, for example, a patient with an obstructed esophagus who can be nourished adequately by gastrostomy feedings but cannot swallow his own saliva. He is able to survive, but mere survival is not enough. Although the preservation of life is of paramount importance, it is important also that patients be able, as Eloesser [1] has said, to "live nobly," and those with a non-functioning gullet cannot. Small wonder, then, that efforts to restore the ability to eat normally by the construction of an acceptable esophageal substitute have engaged the attention of surgeons for many years. Attempts to develop a safe and satisfactory esophagoplasty began prior to the turn of the century, and through the years a wide variety of technics have been tried. The failures and disappointments have been many, but evidence is accumulating which suggests that a solution to this problem is at hand. Before describing the technic which appears to represent the present method of choice in esophageal reconstruction, it may be of interest to review briefly the historical background leading to the development of the procedure currently favored.

HISTORICAL REVIEW

Skin Tubes. Pioneer efforts to solve the problem of esophageal reconstruction are credited to Bircher [2] who, in 1894, constructed a subcutaneous skin tube to bridge the gap between the stomach and the intact portion of the proximal cervical esophagus. Beck and Carrell [3], Jianu [4] Halpern [5] and others employed modifications of the original method, consisting essentially of the construction of a pedicled gastric tube which, when swung upward beneath the skin of the anterior chest wall, necessitated a shorter cutaneous tube to join the upper end of the gastric tube to the healthy segment of esophagus above. Efforts to use skin tubes as an esophageal substitute were persisted in through the years, and as recently as 1949 Bricker and associates [6] reported on the placement of such tubes within the thorax. Although sporadic successes have been achieved with these methods or some modification thereof, technics involving the use of skin tubes have never given consistently good results. Many operative stages are required in this type of reconstruction, making the method an expensive and time-consuming one entailing prolonged and repeated hospitalization. As Yudin [7] has so aptly stated, "the stages of the Bircher operation have become real causes of despair for the surgeon as well as the patient." Fistulization is frequent, recurrent stricture formation at the upper and lower stomas is a constant threat, and the cosmetic result in those exceptional cases in which the reconstruction is successfully completed leaves much to be desired.

The Stomach. In 1920, Kirschner [8] used the stomach as a substitute for the obstructed esophagus, bringing it up in an antethoracic

subcutaneous tunnel to the neck where it was anastomosed to the uninvolved cervical esophagus. Distally, a Roux–Y jejunal loop was constructed, the free jejunal limb being joined to the distal esophageal segment and the duodenum being anastomosed to the jejunum end-to-side. In 1938 Adams and Phemister [9] performed the first successful resection of a carcinoma of the lower third of the esophagus with primary reconstruction using the stomach intrathoracically as a replacement. As experience with this technic has increased, higher and higher resections have been performed with intrathoracic or cervical esophagogastrostomy as the method of reconstruction. Garlock [10] and Sweet [11] have participated prominently in these advances, although it appears that O'Donnell [12] performed the first total esophagectomy for cancer with reconstruction by transthoracic, transcervical pharyngogastrostomy. Esophagogastrostomy has continued to be the most popular method for esophageal reconstruction following resection for cancer. Mes [13] has devised a technic of creating a tube from the greater curvature of the stomach, with perhaps a "turn-back" on the lesser curvature at the cardia, which greatly increases the length of the gastric tube available for transposition into the chest or high into the neck. This method affords an adequate length of stomach for total esophageal substitution, and it has been heartily endorsed by Wangensteen [14]. The stomach has definite advantages as an esophageal substitute which account for the popularity its use has achieved. It is readily available, has an excellent blood supply, and in many patients adequate mobilization permits the stomach to be brought up to quite a high level, even to the pharynx. Transthoracic esophagogastrostomy is technically an easy operation to perform. Despite these favorable features, however, there are definite disadvantages associated with its use. The esophagus does not tolerate gastric secretions well and esophagogastrostomy is frequently followed by severe peptic esophagitis due to reflux. This entity is one of considerable importance. It gives rise to highly annoying symptoms and results in serious impairment of the patient's health and nutrition. Stricture formation is a common sequela and necessitates dilatation or even surgical relief. The vagotomized stomach may dilate with resultant respiratory or cardiac embarrassment, a situation which is aggravated by the associated pylorospasm. This requires some form of ancillary operation to assure gastric emptying of the atonic stomach which results from section of the vagi. High cervical anastomoses frequently result in the aspiration of regurgitated gastric contents, and this may lead to acute aspiration pneumonitis or chronic suppurative pulmonary disease. These undesirable characteristics are sufficiently important to render the stomach unsuitable for routine use as an esophageal substitute, particularly in young persons with benign lesions. This is doubly so if the lesion is situated at a high level.

The Jejunum. Roux [15] of Luzanne and Herzen [16] of Moscow simultaneously and independently in 1907 first used the jejunum as a replacement for the esophagus, following a suggestion made by Wullstein [17] three years earlier. Roux utilized an isolated jejunal loop with anastomosis to the esophagus above and the stomach below. Herzen transected the jejunum proximally only, the distal end of the divided jejunum being anastomosed to the esophagus above with restoration of gastrointestinal continuity by end-to-side jejunojejunostomy below. Herzen brought the jejunal segment up through a slit in the transverse mesocolon and the gastrocolic ligament in order to prevent compression of the vascular pedicle by the transverse colon. He also obviated total gastric bypass by anastomosing the jejunal limb to the anterior surface of the stomach side-to-side. Both Roux and Herzen brought the jejunum up in subcutaneous tunnels on the anterior chest wall. Reinhoff [18], in 1946, first transplanted the jejunum within the thorax for esophageal replacement, and Harrison [19] is accorded priority in achieving reconstruction of the entire esophagus by a transthoracic jejunal transplant. Harrison's operation was performed in three stages. Shumacker [20] has also advocated a staged operation, dividing alternate vascular radicles at the first procedure in order to assure an adequate blood supply to the mobilized segment of jejunum and to permit a longer segment to be obtained. Robertson and Sarjeant [21] reconstructed the entire esophagus in one stage, bringing a Roux–Y isoperistaltic jejunal loop to the neck through an anterior mediastinal tunnel. While numerous successful cases of jejunal substitution for the esophagus have been recorded in the literature, this technic has never achieved great popularity or

widespread use. The reasons are quite apparent to those who have had experience with it. As Sweet [22] has said, the operation is not an easy one. Citing the reasons for jejunal failure, Yudin [7] noted that "the arcades are too short, their junctions are extremely thin, the radicle trunks are in many places insufficiently developed, unequally distributed, the mesentery too fat and tears easily." Mes [13] is probably correct in his statement that more jejunal transplants perish than survive. It is generally agreed that the jejunum is a tedious organ to deal with, and its use for high esophageal replacement is fraught with many hazards. On the other hand, Merendino and his associates [23,24] and Allison and his co-workers [25] have had good success in the use of short segments of the jejunum to replace the distal esophagus. It is our impression that the jejunum is satisfactory for this purpose but that the difficulties associated with the mobilization of long jejunal segments, sufficient in length to reach high in the neck or to the pharynx, are so great that the jejunum does not constitute the ideal replacement for all, or virtually all, of the esophagus.

Prosthetic Tubes. In 1922 Neuhoff [26] proposed and constructed experimental "granulation tubes" developed over a stent. He hoped that when united to the esophagus proximally and distally, the tube would become lined by an ingrowth of esophageal epithelium. Apparently this method was never used clinically and, if so, it did not achieve general acceptance. Berman [27,28] has used prosthetic tubes to replace the esophagus both experimentally and clinically, but this technic has not gained favor. Neville and Clowes' [29] opinion that this method should not be used in human subjects probably represents the consensus.

The Colon. Utilization of the colon as a substitute for the esophagus is not a new procedure. In 1911 Vulliet [30] employed the transverse colon in antiperistaltic fashion to replace the esophagus. In the same year Kelling [31] reported a similar operation except that the colon was anastomosed in an isoperistaltic manner. Each of these authors placed the mobilized segment of colon in an antethoracic subcutaneous tunnel. The colon substitution technic did not achieve favor, however, until recent years when more efficient methods of bowel sterilization became available. Within the past decade, use of the colon to replace the esophagus has been revived, principally by French surgeons [32–34], usually in the form of subcutaneous transplants following palliative resections for esophageal carcinoma. Rudler [32] used a retrosternal transplant of ileum and ascending colon with distal anastomosis to the jejunum. Lortat-Jacob [33] employed the ascending and transverse colon to bypass an esophageal stricture, also with distal anastomosis to the jejunum.

Little has been written about intrathoracic transplants of the colon to replace the esophagus. Robertson et al. [35] reported in 1952 the transthoracic interposition of a segment of transverse colon between the esophagus and jejunum. In 1953 Kergin [36] employed a mobilized segment of transverse colon for intrathoracic bypass of a high esophageal obstruction due to a paraffinoma. The following year Mahoney and Sherman [37] and in 1955 Sherman and Dale [38] described their experiences in using the right colon as a substitute for the esophagus in a patient who underwent resection for carcinoma and in an infant with congenital esophageal atresia. Christophe [39] in 1951 and Bosher et al. [40] in 1955 reported on the use of the left colon for esophageal replacement. More recent articles describing the employment of the right and transverse colon for this purpose are those of Neville and Clowes [29] and Scanlon and Staley [41]. The latter two groups of workers both advocate retrosternal anterior mediastinal placement of the transplanted colon. Neville and Clowes [29] have recorded the largest group of cases in which this method was used (twenty-eight), while it appears that Scanlon and Staley [41] were among the first to employ this technic. The latter authors have pointed out the several features which establish the colon as a desirable substitute for the esophagus, namely, "adequate length, a good marginal blood supply, limited bulk, and a resistance to peptic digestion" [41].

LYE STRICTURES

Cicatricial strictures and other obliterations of the esophagus due to the ingestion of lye or other caustic chemicals are not common, but they are encountered often enough to be of practical importance. These lesions are most often seen in young children who drink lye by mistake, or in young women who ingest the material with suicidal intent. The fact that they usually occur in otherwise healthy children or

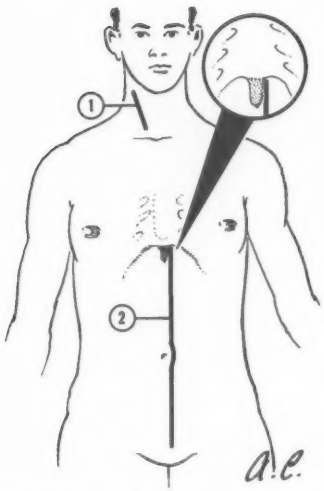


FIG. 1. The location of the cervical (1) and abdominal (2) incisions. The cervical incision may be on either the right or left side of the neck. Note that the abdominal incision does not begin at the tip of the xiphoid but at the xiphosternal junction as shown in detail in the inset.

young adults is responsible for their attracting an unusual degree of interest and attention. Acute chemical burns of the esophagus often can be managed successfully by dilatation if the extent of mucosal destruction is not too great. However, in patients in whom large areas of esophageal mucosa is destroyed, the normal epithelial lining cannot regenerate, and severe stricture formation is the inevitable result. Patients so afflicted are doomed to either repeated painful dilatations or permanent gastrostomy feedings. Many patients are unwilling to submit to continual esophageal bougienage over a period of many months or years with no real assurance of permanent relief. Admittedly this method of management is disagreeable and not without danger. The alternative, a permanent gastric fistula, is physically uncomfortable and psychically traumatic. In view of these rather dire prospects, early surgical restoration of the continuity of the alimentary tract would appear to be in order when a patient is seen with an extensive lye stricture which has not responded to dilatation.

TECHNICAL CONSIDERATIONS

A preoperative barium enema should be obtained in order that a silent lesion in the colon is not overlooked. This will also give some idea of the length of the colon, although the amount available for esophageal replacement depends primarily upon the particular arrangement of the blood supply, which can be determined only at operation. Debilitated patients should be treated vigorously in order to achieve an acceptable nutritional status. Blood transfusions are indicated if necessary for the restoration of a normal circulating blood volume. Vitamin supplements are advisable. Attention should be directed to the patient's oral hygiene, and dental caries should receive appropriate treatment. The bowel preparation consists of the use of Neomycin,® Sulfasuxidine,® cathartics and cleansing enemas. The patient should receive a low residue diet for several days immediately preceding operation.

At operation, endotracheal anesthesia is employed and the patient is placed in the supine position. The entire neck, chest and abdomen are prepared and the patient is draped so as to permit access to these areas. A midline abdominal incision is used, extending from 1 inch above the xiphoid to 1 inch below the umbilicus. (Fig. 1.) The abdomen is explored, and the cecum, ascending colon and transverse colon are inspected and their blood supply carefully examined with the aid of transillumination. The right colic artery and vein are identified and dissected free at their origin, and separately occluded with small non-crushing bulldog clamps. The major branch of the ileocolic artery supplying the ileocecal region is likewise freed and clamped, as is its accompanying vein. At this time the blood supply to the right colon and terminal ileum is dependent upon the middle colic artery through the marginal arteries. While the adequacy of this is being tested, the appendix is removed if present. Our experience confirms the opinion of Scanlon and Staley [41] that insofar as the vascular problem is concerned, the venous drainage is more important than the arterial supply. We have seen good arterial pulsations in the ileocecal region while the bowel in this area has assumed a faint bluish discoloration. This finding, however, has never been sufficiently striking to prevent us from successfully using the right colon as planned. If the blood supply to the right colon is judged to be inadequate, one may make a similar test on the left colon by proximal clamping of the left colic artery and vein. This segment of bowel may be used equally well if its blood supply proves to be satisfactory.

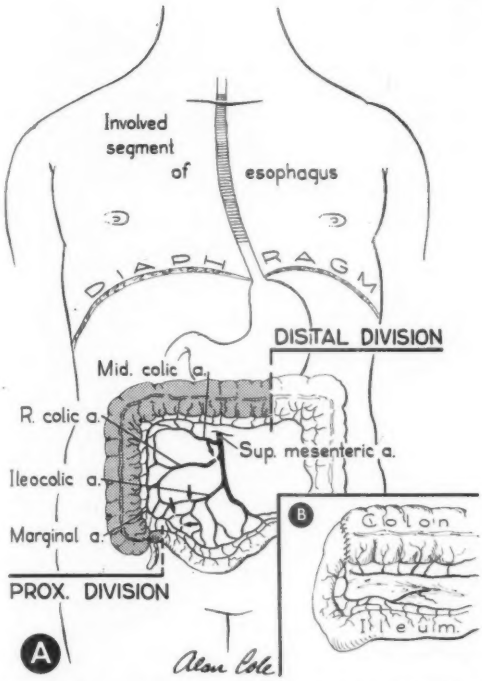


FIG. 2. The segment of colon to be transplanted (shaded) is shown in (A). Arrows indicate the points of division of the vessels and illustrate the blood supply to the mobilized bowel from the middle colic artery via the marginal vessels. Inset (B) shows restoration of intestinal continuity by ileocolostomy.

When utilizing the right colon, the point of division of the bowel is selected after careful estimation of the length of colon that will be available for transplanting into the chest. (Fig. 2.) In patients with a long mesentery and a fortuitous arrangement of the major vascular radicles, no terminal ileum need be taken and the bowel may be divided immediately proximal to the ileocecal valve. When the point of division of the bowel has been elected, the previously clamped major vessels are triply ligated with silk and severed between the central and distal ligatures. When the bowel is divided at the ileocecal valve, the distal ileum is turned in by two layers of interrupted silk sutures. If it appears that additional length may be needed, a segment of ileum up to 30 cm. in length may be left attached to the colon, according to Scanlon and Staley [41], although we never have taken a segment of ileum exceeding 10 cm. in length. Proximal division of the

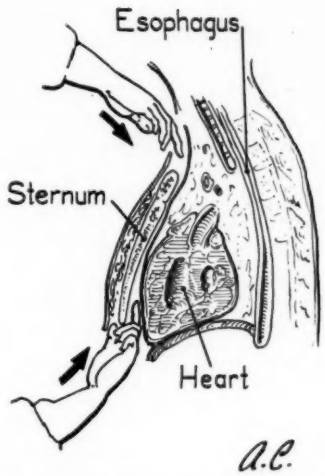


FIG. 3. Creation of the substernal tunnel by blunt finger dissection from above and below.

mesentery of the retained segment of ileum is done with due attention to its blood supply. The right colon is mobilized by division of its avascular lateral peritoneal reflections, this mobilization being carried around the hepatic flexure. The mesentery of the cecum, ascending and right half of the transverse colon is divided at its root so as to leave the mobilized colon suspended from a vascular pedicle consisting of the middle colic artery and vein. The great omentum is removed from the right half of the transverse colon and the colon divided to the left of the middle colic artery. Gastrointestinal continuity is restored by ileocolostomy.

Attention is next directed to the neck, and an incision is made paralleling the medial border of the sternocleidomastoid muscle. (Fig. 1.) This may be either on the right or left, depending on the surgeon's choice. The carotid sheath is retracted laterally and the cervical esophagus is exposed, care being exercised to isolate and preserve the recurrent laryngeal nerve. Division of the inferior thyroid artery and middle thyroid vein permits the corresponding lobe of the thyroid gland to be rolled medially which affords additional exposure. After exposure and mobilization of the healthy segment of cervical esophagus, working from both above and below, an anterior mediastinal tunnel is created by blunt dissection with the fingers. (Fig. 3.) Inferiorly, the xiphoid may be resected if it is long. The substernal attachments of the

diaphragm are detached so as to enlarge the anterior substernal space. If one dissects carefully, the pleura may be pushed laterally to either side and entry into either pleural space avoided. By staying close to the undersurface of the sternum at all times, it is possible to insert the entire hand into the tunnel without embarrassment to the heart. The dissection from below is superficial to the endothoracic fascia, while superiorly it is deep to this layer. It is important to make the upper opening in this fascia sufficiently wide to prevent constriction of the transplanted colon or its blood supply.

Possible injury to the internal mammary vessels does not present a hazard, for they are protected by the transverse thoracic muscles. The superior thoracic aperture may be somewhat narrow so that there is some compression of the colon as it makes its exit from the anterior mediastinal tunnel to the neck. When this situation prevails, the head of the clavicle may be resected, and if necessary an appropriate segment of the manubrium rongeured away in order to provide ample space.

When the tunnel has been prepared, and prior to bringing up the colon, the esophagus is transected in a healthy area above the beginning of the stricture. This point may lie anywhere between the pharynx and the level of the sternal notch, depending upon the pathologic condition present. With complete esophageal strictures the division must be performed at the pharyngoesophageal junction. The distal esophageal segment may be handled in one of two ways. A tube may be inserted in it and brought out as a mucous fistula, which will soon close spontaneously, or the distal esophagus may be closed in two layers with interrupted silk sutures. We have employed the latter technic; a mucocele has not formed and no harm has resulted. We are convinced that no attempt should be made to resect the involved segment of esophagus. In the presence of an extensive lye stricture there is an extreme degree of periesophagitis, and the damaged esophagus lies frozen in a bed of dense chronic inflammatory tissue. Efforts to remove the strictured organ entails much operative trauma with significant blood loss and a real hazard of damage to contiguous vital structures. Although it has been stated that carcinoma is more likely to develop in an esophagus which harbors a lye stricture than in one which is healthy, valid statistical proof to this effect has not been offered. Even if a slightly increased incidence of cancer in this situation could be shown, it is doubtful that the possibility of such an eventuality in a given case would warrant the increased morbidity and mortality associated with resection. Among four colon substitutions for the esophagus performed by one of us (C. F. S.), the one death occurred in a patient in whom an ill-advised removal of the diseased esophagus was performed. This woman's death from cardiac arrest was the result of needlessly prolonged operating time, great blood loss and surgical shock.

When the mobilized segment of colon is ready to be brought into the neck, a stout figure-of-eight suture is passed through the seromuscular coat of the proximal end of the divided bowel and grasped by a long instrument passed through the anterior mediastinal tunnel from above downward. This suture is not used to pull the bowel up through the tunnel, but rather merely to guide it as it is gently and carefully pushed up from below. Great care is exercised to avoid twisting the bowel or injuring its blood supply. The colon may be brought from the abdomen to the anterior mediastinal tunnel either anterior or posterior to the stomach. When the latter route is used it makes its exit through a rent which is created at a favorable site in the gastrohepatic mesentery. This is the shortest route to the neck from the abdomen and offers the additional theoretic advantage of eliminating the possibility of compression of the stomach by the vascular pedicle. However, the length of the bowel has not been a problem in the four patients in whom we have used this technic, nor has the likelihood of compression of the stomach by the middle colic artery and vein been apparent. We have therefore passed the colon into the tunnel anterior to the stomach in all cases, and have encountered no difficulties in the three surviving patients.

When the colon is properly situated in the neck it is measured as to the adequacy of its length and blood supply. We have found the vascular status to be excellent in all patients, and there has been an excess length of colon available in every case. As a matter of fact, in each patient it has been possible not only to resect any terminal ileum that may have been retained but also actually to remove the cecum and ileocecal valve. This has made it possible

to eliminate two suture lines from the repair (appendiceal stump and terminal ileal closure). Those who have anastomosed the terminal ileum to the esophagus report that the ileocecal valve does not interfere with the ingestion of food nor does it destroy the ability to regurgitate. The colon (or ileum) is anastomosed to the healthy proximal esophagus (or pharynx) in two layers using interrupted fine atraumatic catgut for the inner layer, which includes only the mucosa, and fine atraumatic silk mattress sutures in the outer layer, which includes the muscular coats of the esophagus and the seromuscular coat of the bowel. (Fig. 4.) If the cecum is used for this anastomosis, a button of tissue about 2 cm. in diameter should be excised in order to avoid stenosis at the anastomotic site. The anastomosis may be performed over a large stomach tube if desired, although we have not found this to be necessary. Upon completion of the anastomosis a small Penrose drain is split in a vertical direction; one arm is carried downward and placed near the closed distal esophagus, and the other is carried upward to the vicinity of the esophagocolostomy. The undivided arm of this T-shaped drain is brought out through a stab wound at the lateral border of the sternocleidomastoid muscle. The cervical incision is closed in two layers with interrupted silk sutures. The distal end of colon is then anastomosed to the stomach, usually low in the antral region near the lesser curvature, although the site of this union is probably unimportant. (Fig. 4.) If the colon has been brought up posterior to the stomach, posterior cologastrostomy may be performed, although this has been said to predispose to regurgitation. In most instances when the retrogastric route is used, it is still possible to perform anterior anastomosis. If excess colon is present at the distal end it should be resected before cologastric anastomosis is performed. This eliminates the possibility of a redundant loop.

Since the vagus nerves have been preserved, no procedure to facilitate gastric emptying is indicated. The mesentery of the distal transverse colon and the terminal ileum are united to prevent herniation of the small bowel, and the right posterior abdominal parietes are reperitonealized. Virtually all patients operated upon for lye strictures already have a gastrostomy, and this is left undisturbed throughout the operative procedure. The abdomen is closed

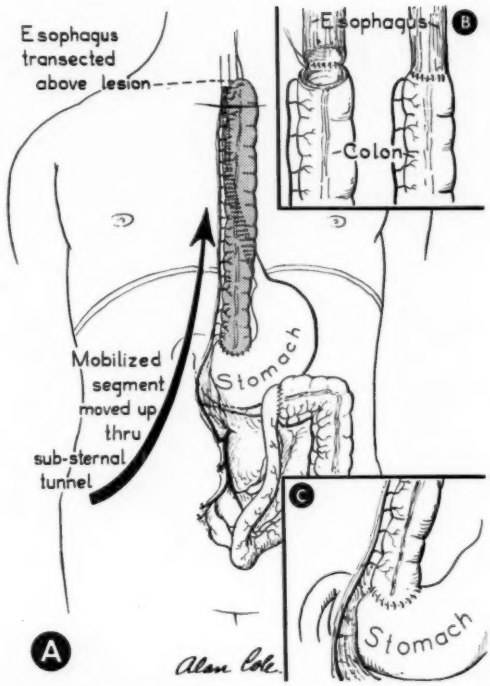


FIG. 4. The mobilized segment of colon has been placed in the anterior substernal tunnel in isoperistaltic fashion (A), guided up by a stout suture in the tip of the cecum. Note that the diseased esophagus is *not* removed. Here the vascular pedicle passes anterior to the stomach. The retrogastric route may be used optionally. Inset (B) illustrates the anastomosis between the proximal esophagus and the cecum and (C) the cologastrostomy.

in layers without drainage. The gastrostomy tube is connected with a drainage bottle upon completion of the operation and left open in order to prevent gaseous distention of the stomach or the accumulation of gastric secretions.

The patient is maintained on intravenous fluids in the early postoperative period. Gastrostomy feedings may be resumed in three to four days or as soon as active peristalsis has returned. Nothing is given by mouth for seven days. At the end of this time oral liquids may be started with rapid progression to an unrestricted diet. Because the esophagus lacks a serosal layer, early sealing of the esophagocolostomy does not occur; it is not unusual for a small leak to develop at the proximal anastomosis. If this occurs, oral alimentation is withheld and rapid spontaneous closure can

be anticipated. When the drains are still in place, these small leaks create no particular difficulty. If the drain has been removed, adequate drainage must be provided. Only after a full diet by mouth is well tolerated is the gastrostomy allowed to close. If a simple Stamm gastrostomy has been performed, the gastrostomy tube is simply removed and prompt spontaneous closure will ensue. If the gastrostomy is of the Janeway type, surgical closure is necessary. The clinical response of patients who have been treated successfully by this method is indeed very gratifying. Their nutritional status promptly undergoes marked improvement, and the favorable change in their mental outlook is perhaps even more striking.

CASE REPORT

A twenty-eight year old Mexican woman was first hospitalized in May 1946 due to inability to swallow, progressive weight loss and malnutrition. Her medical history revealed that she accidentally drank concentrated lye in a darkened bathroom in April 1946. Four weeks later she was markedly emaciated and was able to swallow only sips of water. Esophagoscopy revealed scarring of the mucous membranes from the level of the cricoid cartilage, with progressive narrowing to complete stenosis 4 inches below the cricoid. Attempts to pass a tube were unsuccessful. A string was successfully swallowed, and bougie dilatation and oral liquids were started. The patient was discharged but was readmitted in June 1946. when the string was accidently broken. At this second admission attempts to dilate the stricture or to again pass a string were unsuccessful. Because of this a Janeway gastrostomy was performed on June 28. Retrograde esophagoscopy revealed strictures as far down as the cardia, and retrograde bougie dilatations were started. These were not successful and the patient was discharged in September 1946 with a tube gastrostomy. Following discharge from the hospital, she did not obtain medical follow up for her gastrostomy until 1958.

Positive findings on medical examination revealed the patient was 5 feet, 1½ inches tall and weighed 96 pounds. The blood pressure was 110/70 mm. Hg. Salivary excretion was not excessive but could not be swallowed. Pallid mucous membranes, poor muscle turgor and generalized muscle wasting were present.

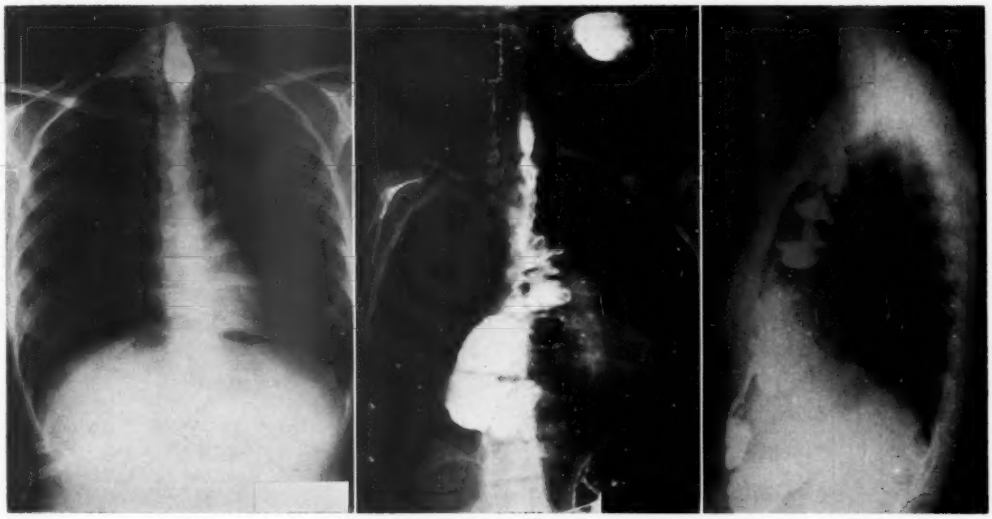
Laboratory examination revealed a hemoglobin of 8 gm. per cent; red blood count, 3,580,000 per cu. mm.; hematocrit, 35 per cent; white blood count, 6,500 per cu. mm., differential, normal. Total serum proteins were 7.45 gm., with an albumin of 2.94 gm. and a globulin of 4.51 gm. The sedimentation rate (Wintrobe method) was 5 mm. Serology was negative. Urinalysis revealed a specific gravity of 1.024; albumin, negative; sugar, negative; microscopic examination, normal. X-ray examination of the esophagus by barium swallow revealed complete obstruction of the esophagus at the level of the third dorsal vertebra. (Fig. 5A.) The patient was instructed in a tube feeding diet with 800 gm. of carbohydrate, 300 gm. of protein and enough fat to make 5,000 calories. A therapeutic liquid vitamin preparation and intramuscular administrations of iron were started. Two weeks later the patient had gained 7½ pounds and values for hemoglobin and serum albumin had improved. Two days later she was hospitalized for surgery.

The patient was operated upon at Mercy Hospital on June 6, 1958. The procedure described was performed. The cervical anastomosis was performed at the level of the cricoid cartilage after exposure of the uninvolved proximal esophagus by the right cervical approach. An excessive length of colon was found to be available, and the cecum and ileocecal valve were resected. The distal esophageal segment was closed in two layers. Cologastrostomy was performed on the anterior wall of the stomach low on the lesser curvature. The procedure was quite well tolerated and the patient's postoperative course was remarkably smooth. She was completely afebrile during the postoperative period except for a single elevation of temperature to 100.2°F. on the fourth postoperative day. A tiny cervical mucous fistula developed on the same day but soon closed spontaneously. She was discharged on the fourteenth day after surgery. She was readmitted on August 17 for closure of her Janeway gastrostomy which was accomplished uneventfully. A postoperative barium swallow revealed prompt passage of the barium through the transplanted colon into the stomach. (Figs. 5B and C.)

The patient is now taking a regular diet by mouth without difficulty for the first time in twelve years. When last seen on January 31, 1959, approximately seven months postoperatively, she was in her seventh month of pregnancy, had gained 30 pounds and was completely free of symptoms.

OTHER CONDITIONS IN WHICH THIS TECHNIC MAY BE OF VALUE

Although many etiologic factors may play a role in the development of esophageal stenosis or complete obstruction, the principal causes may be grouped into four categories: (1) lye strictures and other chemical burns; (2) congenital esophageal atresia; (3) reflux esophagitis, often associated with hiatus hernia, with stricture formation; (4) carcinoma of the esophagus. The difficulties associated with the management of these lesions is evidenced by the great



5A 5B 5C

FIG. 5. A, preoperative x-ray film with barium swallow showing complete obstruction of the esophagus at the level of the third dorsal vertebra. Postoperative posteroanterior (B) and oblique (C) x-ray films of the esophagus with a barium swallow showing unobstructed passage of the barium through the substernally transplanted colon into the stomach.

variety of technics which have been tried, but it would seem that the majority of them can be managed satisfactorily by colon substitution as will be discussed.

Congenital Atresia of the Esophagus. Although it is uncommon, congenital atresia of the esophagus is not a rare anomaly. It is usually associated with tracheoesophageal fistula. The most frequent finding in this group of defects consists of a blind upper esophageal segment with a fistulous communication between the lower segment and the trachea near its bifurcation. In the majority of these patients it is possible to divide the communication, close the fistula, and restore esophageal continuity by end-to-end anastomosis between the upper and lower segments. This constitutes the ideal treatment and should be accomplished whenever possible. At times, however, the gap between the two ends of the esophagus is too great or the blood supply to the distal segment too precarious to permit this, in spite of extensive mobilization of both esophageal segments. Primary union rarely can be achieved in infants with atresia in the absence of a fistula, for the distal esophagus is usually completely obliterated. When primary anastomosis is impossible or unsafe, an alternative method of management must be adopted. The surgeon is faced with two choices: (1) immediate reconstruction may be attempted, bringing the stomach, jejunum or colon up transthoracically or retrosternally for anastomosis to the proximal esophagus to restore gastrointestinal continuity, or (2) cervical esophagostomy and gastrostomy may be performed and esophageal reconstruction delayed until a later date. Although primary intrathoracic esophagogastrostomy was successfully accomplished in a patient with this anomaly by one of us (C. F. S.) [42] in 1949, this operation cannot be recommended for routine use. It is a procedure of considerable magnitude to undertake in a newborn infant, who is often premature and frequently has pulmonary complications at the time he is referred for surgery. Prone to respiratory infections as they are, these sick infants cannot be expected to tolerate the presence of the stomach in the chest particularly well. Furthermore, even if a successful result is achieved, it is doubtful that the stomach constitutes the ideal replacement for the esophagus due to possible adverse metabolic affects in addition to the other disadvantages already discussed. This matter has been thoroughly considered by Haight [43]. In

the same vein, it is doubtful that these babies would tolerate the long and tedious operation required for jejunal substitution, and the procedure would probably be technically impossible because of the fragility of the jejunal vascular arcades. Although a colon transplant at this stage of life would offer greater security regarding the blood supply, this procedure would also constitute too much surgery to undertake in the neonatal period.

In view of the foregoing, there is general agreement that when primary union cannot be accomplished in congenital esophageal atresia, gastrostomy and cervical esophagostomy should constitute the initial surgical treatment. The former is for feeding purposes and the latter is designed to avoid the aspiration of secretions and the development of pulmonary complications. Lung infections almost invariably supervene in these patients, in spite of the most vigilant nursing care, unless cervical esophagostomy is performed promptly.

Reconstruction should be delayed until the infant is older, stronger and better able to withstand a formidable surgical procedure. Restoration of gastrointestinal continuity in a patient with congenital tracheoesophageal fistula, by delayed construction of a skin-lined tube, was first successfully accomplished by Leven [*44*] in 1939; his was the first patient with this anomaly to survive. Ladd [*45*] and others have also reported successful cases in which this technic was utilized. The failures have far exceeded the successes, however, most patients dying from some complication before completion of the multiple-stage procedure. Sweet [*46*] performed delayed transthoracic esophagogastrostomy in a patient with these defects and obtained an excellent result. As recently as 1950, Potts [*47*] reported a patient upon whom antethoracic esophagogastrostomy, a method previously reported by Reinhoff [*48*] and Bigger [*49*], was performed as a delayed procedure. Potts later transplanted the stomach into the left chest after dividing all the costal cartilages on that side.

Antethoracic jejunal transplantation for replacement of the lower esophagus, joining a skin-lined tube above, has been successfully used by Ochsner and Owens [*50*] and Ladd and Swenson [*51*]. Total reconstruction using a free jejunal loop placed antethoracically was achieved by Longmire [*52*], and has been used with considerable success by Leven et al [*44*]. The latter group reported nine successful esophagojejunostomies in patients with this disorder. In most of these cases the jejunum was later joined to the formerly bypassed stomach, and the patients' nutrition markedly improved following jejunogastrostomy.

The right colon was first employed for intrathoracic esophageal reconstruction as a delayed operation in a patient with congenital atresia by Dale and Sherman [*38*] in 1955. In 1956 Neville and associates [*53*] reported late restoration of continuity in a patient with this disorder by cervical esophagocologastrostomy, using a segment of transverse colon passed to the neck through an anterior mediastinal tunnel. Substernal transplantation of the colon may well emerge as the procedure of choice in patients with this disorder in whom primary union of the esophagus cannot be accomplished. It is preferred by Haight [*43*], who records nine patients managed by this technic with a successful outcome in eight.

Reflux Esophagitis. The frequency and importance of reflux esophagitis has been recognized only recently. Although many etiologic factors may play a role in the development of this entity, it most often results from one of three fairly common causes: (1) prolonged and persistent vomiting from any cause, particularly in children; (2) the long-continued use of an indwelling nasogastric tube; and (3) most commonly, esophageal hiatus hernia. Reflux esophagitis often leads to stricture formation. Definite treatment for this condition has been undertaken successfully only within the past few years. Lasting relief demands resection of the involved distal esophagus and cardioesophageal junction, with restoration of continuity by the interposition between the healthy esophagus above and the stomach of a segment of bowel which is resistant to gastric secretions. In spite of earlier fears to the contrary, both the jejunum and colon have been shown experimentally and clinically to be highly resistant to acid digestion. Allison [*25*] and his English colleagues have favored the use of an isolated segment of jejunum for esophageal reconstruction after resection of the narrowed lower esophagus resulting from reflux esophagitis. Merendino and his associates [*23,24*] also prefer the jejunum for this purpose. Both groups of workers have had a rather large experience on which to base their conclusions, and their results have been excellent. However,

Allison [25] points out that the operation is technically difficult, with many opportunities for mistakes which result in postoperative complications. No large series of cases has been reported in which a colon interposition was used in the management of this entity. Neville [29] achieved an excellent result in one patient treated by this method. Although we have not used this technic in the treatment of reflux esophagitis with stricture formation, in view of its obvious advantages in esophageal replacement which have already been emphasized, we believe that the transverse colon would provide the ideal substitute for the lower esophagus in a patient with this condition.

Carcinoma of the Esophagus. If the colon is a relatively safe and satisfactory substitute for all or most of the esophagus in the management of benign lesions, the question naturally arises as to its usefulness in the treatment of esophageal carcinoma. The question is a reasonable one and merits thoughtful consideration. The fact that the percentage of five-year survivals is pitifully low in patients with cancer of the esophagus is well known. Considerably less than 3 per cent of the patients with this malignancy live as long as five years from the time of diagnosis, regardless of the method of treatment [54]. It is perhaps not as well known that among those patients who die of this type of cancer, the lesion is still confined to the esophagus in a significant percentage at the time of death. Ochsner and DeBakey [55] reviewed a collected series of autopsied cases of carcinoma of the esophagus and found that in 41 per cent the cancer had not extended outside the esophagus. In another review of fatal cases, Abel [56] noted that the lesion was resectable in 25 per cent. These findings should inspire surgeons to be more aggressive in their attack upon this neoplasm, in the hope that the dismal outlook of these patients may be improved. That the extent of removal of the involved esophagus has often not been sufficiently radical is indicated by the group of cases reported from Memorial Hospital in New York [57]. In this series of sixty-nine esophagectomies for cancer, histologic examination of the proximal and distal ends of the surgical specimen showed that the resection was inadequate in 45 per cent, inconclusive in 35 per cent and definitely adequate in only 20 per cent. This neoplasm is notorious for its tendency to extensive submucosal spread, and microscopic tumor usually extends far beyond the visible and palpable lesion.

It seems almost mandatory, in view of the statistics just cited, that resections for esophageal carcinoma be more extensive if the surgical results are to be improved. Under the usual circumstances this would involve, at the very least, removal of the entire esophagus distal to the tumor, including also the gastric cardia, as well as resection of the greatest reasonable length of esophagus proximal to the lesion. Extirpation of the abdominal portion of the esophagus, the entire thoracic esophagus, and a part, or indeed all, of the cervical esophagus naturally brings up the problem of esophageal replacement. It would appear probable that in the past the timidity or conservatism of surgeons which impelled them to perform limited esophageal resections for cancer was based, in part at least, on a fear of their ability to replace extraordinarily long esophageal segments. Recent experience in several centers strongly suggests that utilization of the colon, bringing it to the neck or pharynx through an anterior mediastinal tunnel, largely overcomes the previous difficulties in esophageal replacement. Reports relative to the use of this technic are based on its employment in the management of both benign and malignant lesions of the esophagus.

Scanlon and Staley [41] have described a truly radical operation for cancer of the esophagus, a two-stage procedure which appears to have merit in patients with a potentially curable lesion. This involves resection of the entire esophagus, the gastric cardia, the spleen and the tail of the pancreas at the first stage, and reconstruction of the esophagus with the right and transverse colon brought to the neck through an anterior mediastinal tunnel at the second stage. Although we have not used this procedure, we believe that it or some similar technic is clearly indicated in patients who do not, by preoperative studies or at thoracotomy, present evidence of local or distant spread denoting incurability if not actual irresectability.

We are uncertain of the proper role of a procedure of this magnitude, or even the use of the colon as a simple bypass, in patients in whom purely palliative resections are performed or irresectable esophageal cancers are bypassed. The prognosis is so grave in these patients, and their prospect of a reasonable survival under

any circumstances is so poor, that it may be advisable to manage the majority of them by a more simple procedure, such as palliative esophagogastrostomy. While substitution of the colon for the esophagus is not a shocking operation, it is somewhat time-consuming, involves two surgical incisions and several intestinal anastomoses. It is only reasonable to assume, therefore, that this operation would be less well tolerated by elderly debilitated patients with advanced cancer of the esophagus than a less complicated procedure which could be done more rapidly and with less likelihood of postoperative complications. In this connection, it is noteworthy that of four patients with irresectable cancer of the esophagus in whom Neville and Clowes [*29*] used the colon as a bypass, none survived to leave the hospital. In contrast, Mustard and Ibberson [*54*] reported thirteen cases of carcinoma of the esophagus in which a bypass operation was employed, using either the jejunum or colon transplanted to the neck through an anterior mediastinal tunnel. Ten of these patients survived and excellent palliation, in respect to the restoration of the ability to swallow normally, was achieved in nine. They concluded that these bypassing procedures have real merit in the relief of malignant obstruction. Retrosternal substitution using the right colon was employed by Patterson and Robbins [*58*] in five patients with carcinoma of the esophagus and two patients with gastric cancer which extended into the esophagus. Three of five patients undergoing a one-stage procedure died in the early postoperative period, while both of the patients undergoing a two-stage operation survived. The survivors were relieved of their obstruction and their palliation was judged to be good. The use of this operation for palliation of esophageal cancer demands careful selection of cases in order to avoid a prohibitive mortality rate. Only time and further experience will determine its proper place in the management of irresectable cancer of the esophagus.

SUMMARY

Lye strictures of the esophagus are discussed briefly, and highlights in the development of methods of esophageal replacement are reviewed.

The technic of esophagocologastrostomy utilizing the right colon and right half of the transverse colon carried to the neck through the anterior mediastinal substernal route is described. A case is reported of lye stricture of the esophagus in which this method of reconstruction was employed.

CONCLUSIONS

Acquired benign strictures of the esophagus are uncommon, but they are important lesions. Substitution with the right colon, carrying the bowel to the neck through an anterior mediastinal tunnel, appears to be a suitable method for management of these lesions. Reports in the literature indicate that this technic is also a satisfactory one for replacing the esophagus in the management of certain patients with congenital esophageal atresia when primary union is not possible.

The interposition of a relatively short segment of transverse, right or left colon between the healthy proximal esophagus and the stomach after resection of the involved distal esophagus and cardioesophageal junction in patients with peptic esophagitis and stricture formation has had limited clinical application, but there is reason to believe that this technic will prove superior to the methods currently in vogue. The proper role of this operation in the treatment of cancer of the esophagus has not been clearly defined. It may have a definite place in the management of patients with favorable lesions in whom a curative resection is attempted, and as a bypass operation in selected patients with irresectable lesions.

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Preservation of the Airway in Surgery for Goiter

A USEFUL FORCEPS FOR THE DELIVERY OF SUBSTERNAL AND INTRATHORACIC GOITERS

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DESPITE the perfection which thyroid surgery has achieved, the removal of an intrathoracic goiter is still an operation of considerable extent since all of the technical dangers inherent in surgery for goiter are increased [*9,10*]. Technical operative complications, especially those associated with the airway, still contribute to many deaths from surgery on the thyroid [*1*]. Asphyxia and injury to recurrent nerves appear to be the last unresolved but controllable mortality factors.

The three technical considerations of major importance in all surgery for goiter (especially in the substernal and intrathoracic variety) are the maintenance of the airway, the identification and preservation of the recurrent nerves, and the control of the blood supply.

The tracheal compression and breathing difficulties produced by these goiters have been sufficiently documented [*1–3,7,9,10*]. (Fig. 1.)

Delay in removing a nodular goiter which has grown beneath the sternum and clavicles subjects the patient to the risk and mechanical difficulties of delivering a larger intrathoracic goiter through a small superior strait. Since these goiters occur in the older age group, arteriosclerosis, hypertension and myocardial damage further increase the risk [*4,5,10,11,13, 14*]. The added burden of respiratory obstruction is, therefore, poorly tolerated. Hence, the airway must be carefully assessed before operation, safeguarded during surgery, and carefully maintained during the period of recovery [*6,8*].

A narrowed glottic space from previous injury to a nerve, or a compressed trachea from a substernal or an intrathoracic goiter (when there is a question of whether sufficient air will pass through immediately after operation) alerts the surgeon for tracheotomy [*8,9,13*].

In most cases the removal of a goiter which is dislocating and compressing the trachea permits it to spring open and furnish an adequate air-

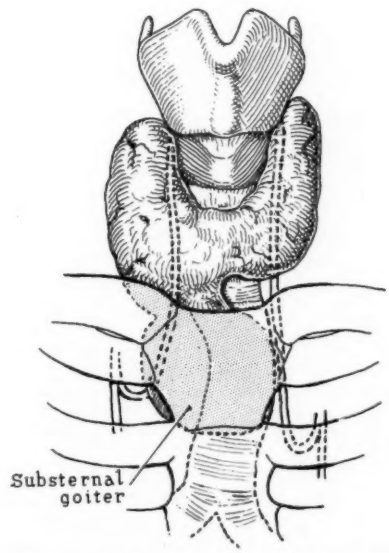

FIG. 1. Anteroposterior collapse of trachea from nodular goiter arising from isthmus and right lobe and wedged behind sternum. Trachea is deflected laterally and compression is anteroposterior. Note how goiter lies in confined space below top of sternum. Relatively slight enlargement from hemorrhage or other cause of goiter in this position may cause severe and even fatal dyspnea owing to confined space in which tumor lies. Hemorrhage into goiter or into goitrous cyst in this location is not very rare, and sudden death from suffocation has resulted from this cause [*10,11,16*].

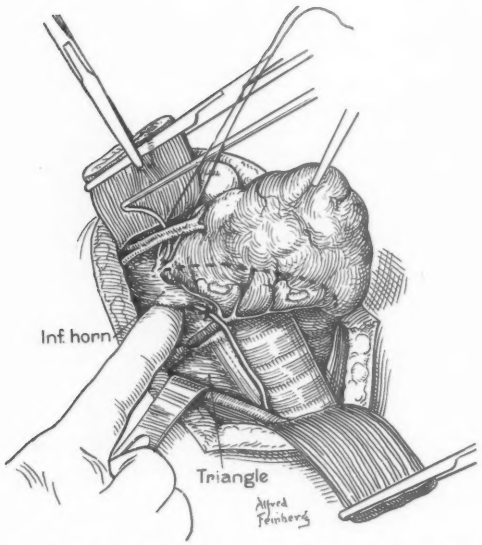

FIG. 2. Author's triangle for localization and protection of recurrent nerve, and method of dealing with blood supply. Note high division and wide retraction of strap muscles.

way. However, tracheal narrowing from a substernal or intrathoracic goiter should always raise the question of whether or not the patient will be able to get sufficient air through immediately after the operation. Thyroidectomies vary in the degree of postoperative intralaryngeal edema. Edema of the larynx following operation may necessitate tracheotomy.

If there is any question as to whether the patient will be able to get enough air through immediately after operation, the trachea is bared and made ready in the event that postoperative tracheotomy becomes necessary. The removal of a few Michel clips and a few sutures from the prethyroid muscles would then give easy access to the bared trachea. Since emergency tracheotomy, however, results in excess mucus and considerable edema of the wound in an already anoxic patient, prophylactic tracheotomy is often better than emergency tracheotomy.

Prophylactic tracheotomy should always be considered when the displacement and compression of the trachea is great, because the maintenance of the airway is so vital during the delivery of an intrathoracic goiter [*1,2*].

The timing of the tracheotomy may be the deciding factor in the survival of the patient.

In large substernal goiters in which the trachea is impinged upon, or in a patient classified as thyrocardiac, it is far better to perform prophylactic tracheotomy at the time of thyroidectomy [*1,3,7,8*]. The patient is usually advised in advance that tracheotomy will probably be performed. Patients with thyrocardiac disease do not tolerate even the slightest degree of anoxemia, and prophylactic tracheotomy avoids the additional cardiac strain. At the conclusion of the operation the tracheotomy tube is inserted through the third tracheal ring and a little iodoform gauze is packed around it. An adequate airway is thus assured, and the tracheobronchial tree can be suctioned frequently if necessary. The tube is usually removed in four or five days and the opening generally heals cleanly, quickly and neatly.

In my experience and that of others [*1–3,7,8*], tracheotomy adds little to the possibility of either mediastinitis or infection in the fascial plane. Moreover, if there is any interference with the breathing, one must accept the risk of mediastinal contamination which is slight compared to the seriousness of suffocation.

During the operation the glottic space can be safeguarded only if the recurrent nerves are protected [*1,7,12*]. Hence, the nerves should be localized and visualized routinely. (Figs. 2 and 3.) In addition, the physiologic voice test should be applied. Therefore, I prefer and use local anesthesia (½ of 1 per cent Novocain®) in over 90 per cent of operations for goiter [*8*]. I have described the technic and a method of localizing and safeguarding the recurrent nerve during thyroidectomy in previous communications [*7*].

Since the blood supply to an intrathoracic goiter comes entirely from above, that is, from the superior and inferior thyroid arteries, the vessels can be well controlled. Venous drainage is largely from branches of the thyroid to the internal jugular vein. The venous connections between the thyroid and the internal jugular vein should be ligated before any approach is made to the intrathoracic goiter. The superior and inferior thyroid arteries in all cases should be ligated before the removal of the intrathoracic mass is attempted. (Figs. 2 and 3.) Since the separation of the intrathoracic mass from its surrounding dense connective tissue and pleura must be accomplished by finger manipulation within the mediastinum, it is

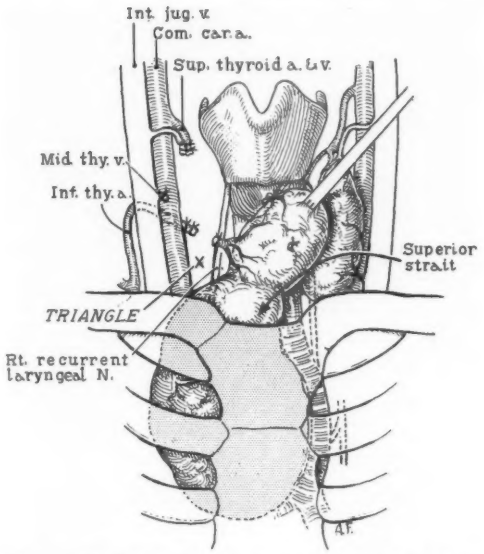

FIG. 3. Technic of removal of intrathoracic goiter. Middle or lateral thyroid vein has been detached in order to offer proper plane of cleavage. Superior pole has been doubly ligated. Inferior thyroid artery has been ligated far back after identification of recurrent nerve which completes boundary of triangle. Entire cervical portion of gland can now be drawn toward trachea and gently raised. It is not wise to produce traction on intrathoracic tumor at this point. Right lobe is next detached from isthmus and trachea, and is now completely free and can be used for slight traction. "Feeder" vessels for intrathoracic mass have now been secured. Intrathoracic tumor can now be delivered while periphery of goiter is pushed back with finger or sponge stick.

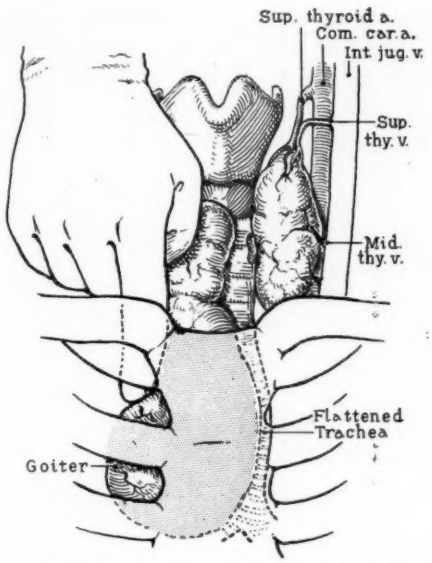

FIG. 4. Enucleation of intrathoracic mass *in situ* should not be attempted. This maneuver compresses trachea and provokes attacks of suffocation.

important to avoid hemorrhage at this time.

Once the cervical portion of the gland is completely detached from its blood supply and from the larynx and trachea, removal consists of freeing the intrathoracic mass digitally from its surrounding dense mediastinal tissue and pleura. The mechanical delivery of the tumor through the upper thoracic aperture is illustrated in Figures 4 and 5.

When the intrathoracic mass is very large and it is impossible to deliver it through the upper thoracic strait, it can be removed either by increasing the diameter of the strait or decreasing the diameter of the tumor. It is important in the removal of a deep intrathoracic tumor not to break the tumor up, if possible, but to remove it as a complete mass.

Fortunately nearly all intrathoracic tumors

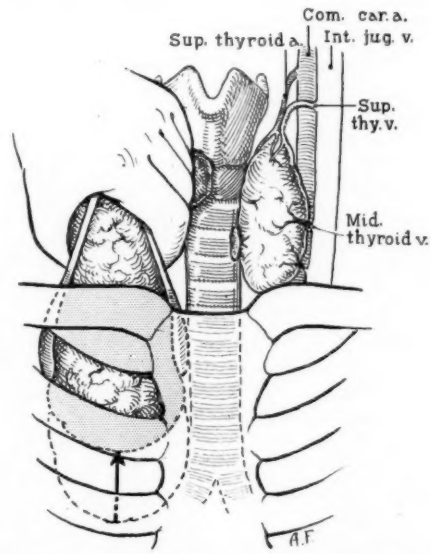

FIG. 5. Method of delivery of intrathoracic goiter, without producing compression of trachea. Note application of forceps and "obstetric" delivery of mass. Small compress in other hand can be used to push back periphery of goiter. Intrathoracic tumor is thus brought forward toward cervical region without producing compression of trachea.

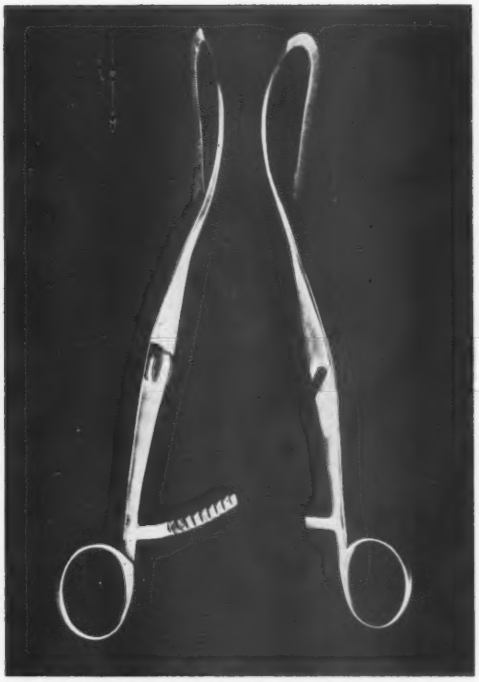

FIG. 6. Each blade is placed around liberated intrathoracic goiter with finger guidance, and blades are locked. Tumor can then be compressed and delivered in "obstetric" fashion.

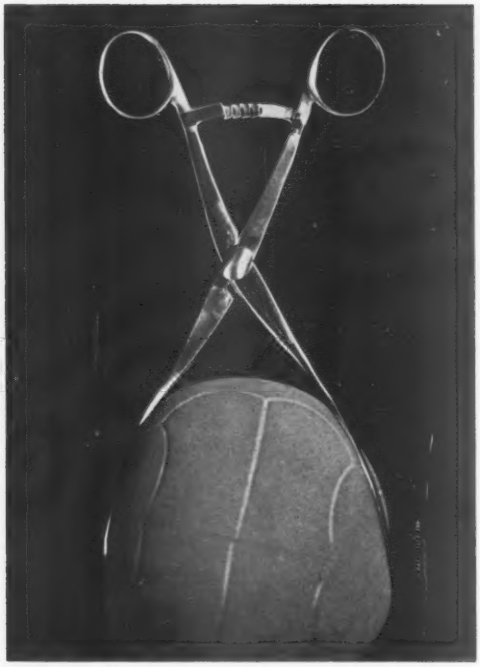

FIG. 7. Forceps assembled, compressing hard, 4 inch rubber ball. Serrated jaws compress tumor and grasp it firmly. Helps extract even the most friable goiters without tearing. Thus, if goiter is malignant, implantation, seeding and manipulative dissemination is avoided.

have a definite capsule with a semi-soft center, even though they are of the multiple colloid variety [1]. Occasionally they are cystic and can be sucked out. The malignant intrathoracic goiters, of course, can become hard, infiltrated and inoperable. Many intrathoracic goiters, however, can be broken down in their centers if necessary. Enormous intrathoracic goiters extending down almost to the diaphragm have been successfully removed in this fashion without splitting the sternum [1]. If necessary, the sternal portions of the sternomastoid muscles can be divided. The prethyroid muscles are always thoroughly separated in the midline, divided high up and widely retracted. (Fig. 2.) I avoid splitting the sternum even though protection is afforded by antibiotics and blood replacement. This procedure produces great postoperative pain and frequent infections follow despite the use of antibiotics.

As stated previously, one must be careful to remove an intrathoracic tumor as a complete mass, for if segments of the devascularized tumor are left behind they may well slough and result in secondary infection and mediastinitis.

In an occasional patient the substernal extension of the intrathoracic goiter will have grown larger than the thoracic inlet, and efforts to deliver it by traction and clamps will be futile. Even though the finger can be inserted into the thoracic inlet and the substernal goiter completely freed of its surrounding attachments, it is still too large to be delivered through the superior strait. In such a situation I have found the principle of delivery employed by the obstetrician to be most helpful, namely, the application of forceps. A small modified obstetric forceps (Figs. 6 and 7) is quite satisfactory for this purpose. This forceps differs from the usual forceps in two respects: the blades are serrated in order to secure a firm grasp of the tumor mass, and the interval from the blade to the shaft is narrowed gradually to eliminate a shoulder. One blade, which can be used as a spoon, is slipped in on one side of the goiter and the other on the other side under

finger guidance; then by applying the usual forceps principle of compression of the mass with traction, the goiter is delivered. (Fig. 5.) A double application of forceps or "Scanzoni maneuver" can be used if necessary. A certain amount of obstetric finesse helps. The delivery should be very slow to avoid tearing large vascular trunks at the lower pole. This maneuver can be combined with the technics suggested by Kocher and Lahey, i.e., removing some of the mass by hollowing out the inside of the large adenoma which has grown into the mediastinum. It is seldom necessary to enlarge the bony outlet of the thorax in order to deliver an intrathoracic goiter [*1,13,15*]. Splitting the sternum produces shock and increases the incidence of postoperative complications and mediastinal hemorrhage. It is important in the removal of an intrathoracic goiter to control all oozing absolutely, for if the slightest amount of bleeding continues the entire mediastinal space and even the chest can fill with blood and the patient can asphyxiate [*1*].

Since pressure on the trachea must be quickly relieved during the removal of an intrathoracic goiter, the aforementioned forceps helps in this maneuver and avoids tracheal compression. (Fig. 5.) The forceps (Figs. 6 and 7) serves as a tractor, a rotator, a compressor, a dilator and a lever, and it helps release the intrathoracic goiter. The most important function is traction and rotation. This long, broad, flat spoon serves to release the intrathoracic mass. (Fig. 6.) As the tumor is delivered with the forceps and drawn upward, all the vessels entering the surfaces of the goiter are divided between ligatures.

After the mediastinal mass has been removed, the cavity is inspected with a good light to make sure that no bleeding veins remain on the attached pleura. A large loose pack of gauze is introduced, completely filling the cavity. This packing is left in for a minimum of one week. The cavity is certain to fill up with fluid and blood if unpacked, thus exposing the patient unnecessarily to the danger of infection and secondary mediastinitis. Such cavities should be drained until they are completely collapsed by the expanding pleura; this often requires about three to four weeks [*1,15*].

SUMMARY

Since anoxemia and asphyxia still constitute by far the most frequent cause of morbidity and death after the removal of intrathoracic goiters, preservation of the airway is of vital importance.

The timing of tracheotomy is discussed. Prophylactic tracheotomy is recommended in all patients with large intrathoracic goiters with marked tracheal compression and deviation, and in patients with thyrocardiac disease.

Localization and visualization of the recurrent laryngeal nerve during operation is advocated.

The management of the blood supply and the mechanism of delivery is described.

An attempt should be made to remove a substernal or intrathoracic goiter *in toto*. This avoids leaving large remnants behind which could possibly cause mediastinitis, or implanting and "seeding" the area if the tumor is malignant.

A new forceps is described which helps in the delivery of the goiter.

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Excision of the Acromial Process for Chronic Dislocation of the Shoulder

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A REVIEW of the literature on chronic dislocation of the shoulder leads to the following generally accepted conclusions. The cause of recurrence is lack of splinting or an inadequate period of immobilization following reduction of the dislocation. Three to four weeks' immobilization are required for adequate follow-up treatment of the original trauma. The primary pathologic disorder found during surgery is a tear in the capsule associated with a tear of the glenoid labrum, and the majority of surgical procedures advocated are aimed at repairing these defects. These surgical procedures usually limit, either intentionally or not, external rotation and abduction. The purpose of this article is to bring into vogue a simpler procedure to cope with the problem of chronic dislocation of the shoulder.

Although we accept the facts of the primary traumatic etiology of the original dislocation and the pathologic disorder found at surgery, we thought the old idea that the acromion acts as a lever to throw the humerus out of joint might be valid.

This was brought to mind by radiographs of the dog (Fig. 1) in which dislocation of the front quarters is a rare occurrence and the acromial process is non-existent. In view of this observation, acromionectomy was first performed at an Armed Forces hospital with a follow up of two months during normal activity; no dislocation occurred. There was no restriction of motion.

The following cases are from the Orthopedic Service of the Veterans Administration Hospital, Birmingham, Alabama.

CASE REPORTS

CASE 1. H. C. M., a forty-one year old white man (Fig. 2), had a ten-year history of bilateral chronic dislocation of the shoulders. The right

FIG. 1. Roentgenogram of a dog's shoulder showing small posteriorly placed acromion.

FIG. 2. Case I. Roentgenogram of shoulder girdle prior to acromionectomy with normal relationships.

shoulder had dislocated at least five times, the left innumerable times. The initiating motion was raising the hand behind the head. This patient was taken to surgery and anesthetized, after which his shoulder was easily dislocated as the arm was abducted, hyperextended and externally rotated. (Fig. 3.) The distal 1½ inches of the acromion was then removed. Following this it was found more difficult to dislocate the shoulder. The patient was inadvertently placed in an abduction splint following surgery. The shoulder was found to be dislocated the following morning, at which time relocation was performed by manipulation and a Velpeau bandage was applied. Postoperative follow-up after two months revealed no recurrence of dislocation.

FIG. 3. Case I. Dislocation of humerus prior to acromionectomy.

FIG. 4. Case III. Shoulder girdle showing normal relationships following acromionectomy.

CASE II. W. R. G., a sixty-seven year old white man, had dislocated his right shoulder twenty-five times in eight years. He had had surgical repair in 1951 to no avail. The patient was hypertensive and cirrhotic. Acromionectomy was performed on January 23, 1958. The patient was discharged from the hospital on February 10. To date there has been no recurrence of the dislocation.

Follow-up examination in December 1958 revealed no loss of muscle strength. The patient works at his usual job and shows no limitation of motion over and above that engendered by the surgical procedure of 1951.

CASE III. S. L. H., a thirty-eight year old white man, was a heavy drinker who came in primarily for repair of a fracture of the tibia with delayed union. It was also noted that there was chronic dislocation of the left shoulder. This patient dislocated his shoulder by the simple act of attempting to roll over in bed. He also had hypertension with asthma. Acromionectomy was performed on July 16, 1957. (Fig. 4.) To date, no recurrence of the dislocation has occurred.

None of these three cases has been readmitted to the hospital for recurrence of the dislocation at the time of this writing.

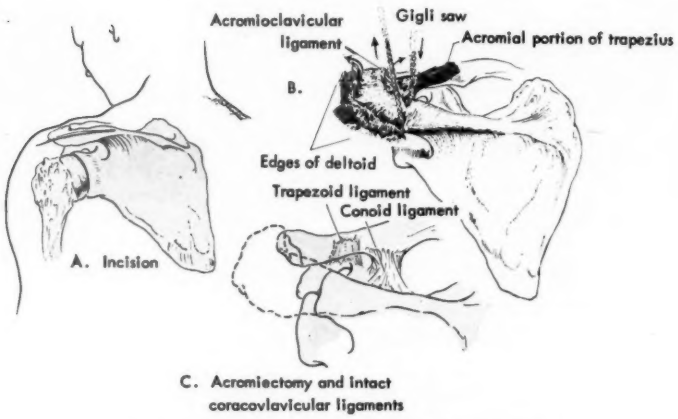

FIG. 5. Schematic diagram of acromionectomy.

Acromionectomy was performed upon these patients for chronic dislocations of the shoulder. The operative approach (Fig. 5) is simple. It consists of making an incision about 3 inches in length over the acromion and lateral third of the crest of the spine. The aponeurosis and attachment of the deltoid are divided, and periosteal elevators are used to separate it from the bony attachment. The trapezius is stripped away at its posterior attachment to the acromion. A Gigli saw is placed under the inferior margin of the acromion at its concaved surface where it meets the crest of the spine of the scapula. The acromion is severed from the spine of the scapula and is disarticulated at the acromioclavicular joint.

As can be seen by a perusal of these three cases, the patients were poor operative risks for the usually advocated surgical procedures. Therefore, this simpler procedure was utilized in the hope that it would obviate further operative interference. In all three patients, success was apparent almost immediately. None required an extended stay in the hospital.

SUMMARY

A simple operative approach to the problem of chronic dislocation of the shoulder is presented. Several points should be stressed. The procedure is simple, and postoperative recovery is rapid. A Velpeau bandage is used for one week postoperatively to maintain joint and muscular integrity, and sling suspension is used after this until the shoulder is comfortable.

Active motion of the shoulder is encouraged during the period of sling utilization. There is no loss of mobility or range of motion following surgery.

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Surgical Exploration of the Ductus Choledochus

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THE purpose of this paper is to describe some maneuvers of importance in surgical exploration of the ductus choledochus. In the daily practice of this generally difficult surgery, I have found them to be of real value, and I employ them routinely in exploration of the common bile duct.

Before attempting any procedure on the common bile duct, it is necessary to identify it clearly among the elements of the hepatic hilum. Anatomy textbooks describe the ductus choledochus as the most lateral and anterior of the components of the porta hepatis. Nevertheless, practice has demonstrated that such a clear-cut arrangement is infrequently found at the operating table. An advanced degree of pathologic change sometimes makes it extremely difficult to identify the common biliary channel because of opacity and thickening of the serosa, lymph node enlargement and sclerolipomatous degeneration of the local cellular tissue. Regional edema and an increase of the precholedochal blood supply also contribute to camouflage the duct and disguise the normal anatomic relationships. The inflammatory changes in the wall of the duct which is thickened by the infectious process with sclerotic metaplasia of the fibrocellular elements also has to be considered. The lumen may be considerably narrowed and, occasionally, nearly filiform. All these changes contribute to make the identification extremely hazardous. Therefore, certain precautionary measures are indispensable to approach it with a reasonable margin of safety.

The operator facilitates his approach to the common duct with a duodenopancreatic mobilization (Kocher's maneuver) which allows a better exposure of the structures.

Whenever the ductus choledochus cannot be identified easily, I aspirate the organ suspected to be the biliary channel with a thin, short, beveled needle on a glass syringe. To obtain bile is the quickest and safest method of demonstrating the common bile duct. This step is believed to be so important that I perform it in all cases, even in those in which the location of the duct seems perfectly clear at first sight. Serious mishaps, such as wounds of the portal vein, have occurred as the result of omitting this safety measure.

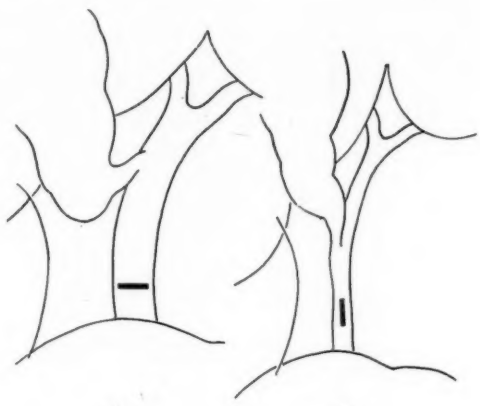
The elective place to perform choledochotomy is undoubtedly the supraduodenal portion of the duct, immediately above the upper border of the first portion of the duodenum. In this area, the risk of encountering a long cystic spearhead which might handicap our intraluminal maneuvers is avoided. Another advantage is that should we later decide to perform choledochoduodenal anastomosis, the biliary stoma is already at the location of choice where all tension on the sutures is avoided.

Transverse choledochotomy is preferable because it preserves the circular fibers of the wall. (Fig. 1A.) I use the longitudinal opening for the very thin ducts in which a transverse cut can very easily become a complete section, even with only slight involuntary roughness. (Fig. 1B.) Such a complication can present the serious problem of reconstructing the common duct. The duct should be carefully dissected free of its serosal layer before it is opened. It is also convenient to perform hemostatsis of the engorged precholedochal blood vessels which create a potential danger of copious bleeding which is difficult to control when these vessels are inadvertently torn. They consist of very thin-walled veins which are firmly attached to the anterior aspect of the duct. A ligature pre-

vents lacerations and ensures a bloodless field. Stay sutures with tags are placed on the anterior wall of the channel, above and below the level where the incision will be made. They detach the wall and allow it to be cut safely. Once the incision is made, the original stay sutures are replaced by new ones, including this time the free edge of the border of both flaps of the incision at the middle point. Sutures are also placed at either end of the choledochotomy. All are left long and tagged. The placement of these sutures is tedious and time-consuming, but it repays all one's efforts by providing a better exposure and easier exploration within the duct. Finally, they simplify the closure of the choledochotomy.

The exploration is begun near the common hepatic duct and its branches. Once the upper part of the biliary tree has been explored, the lumen of the common duct is blocked above the choledochotomy with a small gauze pledget which is rolled into a ball and adequately tagged with a long suture. In this way we avoid the possibility of the ascension of a stone, while exploring the lower part of the duct. Such a calculus could then remain overlooked in the upper portion of the biliary tree. Impacted stones can sometimes be dislodged by introducing a French catheter of adequate size into the duct and flushing it with saline solution. The gush of saline solution can sometimes loosen the calculus which can then be retrieved by the instruments.

Once the surgical and radiologic exploration has been satisfactorily accomplished and the intraluminal procedures are finished, one proceeds to close the choledochotomy. The pathologic anatomy of the biliary tree will indicate whether or not drainage should be performed. When compelled to drain, I prefer not to do it through the choledochotomy and take the long branch of the T tube out through the remaining stump of the cystic duct. A delicate curved clamp is introduced via the cystic duct, pointing in the direction of the choledochotomy, where it grasps the tip of the tube's long branch and pulls it out through the stump of the cystic duct. (Fig. 2.) The lateral branches of the T tube are shortened down to 3 or 4 cm. on either side. The outer half of the lateral branches are also removed, transforming them from a complete cylinder into a segment of a cylinder. They are introduced into the common duct so that one of the branches will remain in



1A 1B

FIG. 1. A, transverse choledochotomy. B, longitudinal choledochotomy.

the ductus choledochus and the other in the common hepatic duct. When the cystic duct's spearhead is excessively long and hinders the passage of the clamp, I try to perforate it. When tough and fibrosed, it becomes necessary to cut it with a narrow-bladed scalpel or a tenotome, pushing it between the tips of the slightly opened branches of the clamp. This method of placing the T tube allows for a tight closure of the choledochotomy and prevents any effusion of bile in the immediate postoperative period and at the time the tube is removed. Also, although this is a more remote possibility, it prevents scarring of the wall of the duct, induced by the constant irritation produced by friction of the tube against the edges. Eventually it may protect against the formation of a stricture. When the diameter of the duct is too wide for the tube, it is reduced with one or two sutures, as another precautionary measure against bile drainage into the peritoneum. I never tie the duct over the tube's long branch with ligatures, because this may be a serious handicap at the time of removal of the T tube. Care should be taken to place the stitches by the side of the tube, taking only the edge of the stump of the cystic duct in their bite.

The choledochotomy is closed with interrupted sutures of non-absorbable material. When the wall is thickened, the stitches are non-perforating. (Fig. 3A.) Only very fine needles are used, with the thinnest material available. In case the wall is thin, sutures

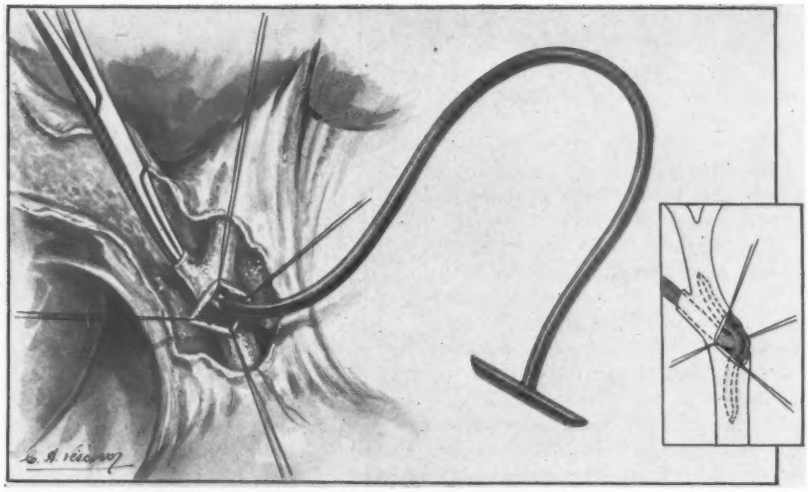
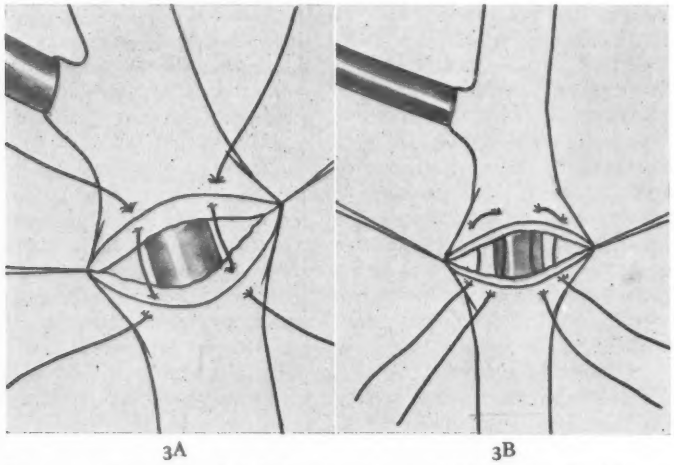


FIG. 2. The clamp is shown picking the tip of the long branch of the T tube to pull it through the remaining stump of the cystic duct.



3A 3B

FIG. 3. A, suture of the choledochotomy (in case of thickened wall) with non-perforating stitches. B, suture of a thin-walled choledochus with perforating, horizontal "U" stitches.

perforate the mucosa and a vascular type of closure with individual horizontal "U" stitches is used. (Fig. 3B.) The suture line is tested by flushing the biliary tree with normal saline solution which is inserted through the tube with a syringe. In the event of leakage, the suture line is reinforced with individual stitches. The closure is peritonealized, uniting the free borders of the serosal cover of the common duct, which had been dissected at the beginning of the procedure. Separate stitches of non-absorbable material are also used here.

Whenever possible, the tube is covered, suturing over it the free borders of the peritoneum which attached the gallbladder to the lower aspect of the liver. This walling-off of the tube has several advantages: it prevents kinking, since the tube is made to follow a straight line from the stump of the cystic duct to the abdominal wall; it also prevents the formation

of adhesions to the adjacent viscera, thus facilitating the removal.

The T tube is always brought through the abdominal wall through a stab incision which is adequately placed to prevent kinking. This allows for the complete closure of the incision and enhances primary healing. If the tube is brought through the incision, it is prone to cause a small incisional hernia which can be painful for a long period of time. Tubes, particularly those which remain in place for a long period of time, act as foreign bodies in the wound and cause a certain amount of secretion. A Penrose drain is inserted down to Morison's pouch. This is left in place only twenty-four to forty-eight hours as another security measure against the accumulation of fluid or eventual escape of bile.

SUMMARY

Some technical details which I routinely use in exploration of the common bile duct are described.

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CASE REPORTS

Granular Cell Myoblastoma of the Breast

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THERE are numerous lesions of the breast which may be confused with cancer on frozen section: fat necrosis, sclerosing adenosis, plasma cell mastitis. We have had recent experience with another entity which must be added to this list, namely, granular cell myoblastoma.

CASE REPORTS

CASE I. A forty-four year old white woman was admitted to the Boston City Hospital on October 7, 1956, with a history of a mass in the right breast of four months' duration. It was first noticed while bathing and except for a gradual increase in size has remained asymptomatic. The past history was noncontributory. The family history revealed that the patient's mother and sister had cancer of the breast.

Physical examination was essentially normal except for a 1 cm. fully movable, hard mass in the right breast. It appeared to be attached to the skin but not to the underlying fascia. Radiographic studies showed no evidence of malignancy, and an excision biopsy was performed with the patient under general anesthesia on October 15, 1956. The frozen section report was "carcinoma." However, the operating surgeons were not convinced that this was a carcinoma, and they decided to postpone surgery until routine pathologic studies were performed.

The final report (Mallory Institute of Pathology) was as follows:

"Specimen consists of two ellipses of skin each measuring approximately 2 cm. in length and 0.2 cm. in width. They have been excised to a depth of approximately 1.5 cm. and include a generous amount of fat and a nodule just beneath it. The nodule measures 1 cm. in diameter and is quite firm.

"On microscopic examination the specimen consists of essentially normal overlying epidermis and dermis. Situated deeply in the subcutaneous fat and fibrous tissue, there is a fairly discrete neoplasm that in its most superficial extent comes into contact with the overlying dermal fibrous tissue. (Fig. 1.) The mass is well encapsulated on its deepest aspect, but on the more superficial region there are cords and tongues of tumor tissue that apparently infiltrate or project into cleavage planes between the bundles of collagen within the dermis. The nodule itself is solidly cellular and composed of discrete masses of cells separated by a loose fibrovascular stroma. The individual cells that comprise the mass are varied in size and shape, some being round and others ovoid, with some flattened into spindle form. All have a fairly well identifiable cell membrane with abundant pink granular cytoplasm and round to oval nuclei. (Fig. 2.) While the cytoplasm is fairly uniformly granular, occasional cells have a loose cytoplasmic structure punctuated by stippled granules suggesting the possible presence of minute droplets of lipid. The nuclei have a prominent limiting membrane with loose stippled chromatin and a small eccentric nucleolus. While the cells vary in shape, there is little variation in size, and the nuclei are fairly uniform. No tumor giant cells are present. There is no mitotic activity or other alteration that could be interpreted as significant anaplasia. The diagnosis is 'granular cell myoblastoma.' "

CASE II. A thirty-two year old married white woman was admitted to St. Vincent's Memorial Hospital, Bridgeport, Connecticut, on April 11, 1954, with a lump in the left breast. Approximately three days prior to admission, she noticed a small lump in the left breast while drying after a shower. She had no previous symptoms in either breast except for some occasional swelling of the breasts associated with menstrual periods. Her general health was good, and her only other complaints were postural backache and frequency of urination. Her past history revealed that she had an incomplete abortion in 1953, for which a dilatation and curettage had been performed.

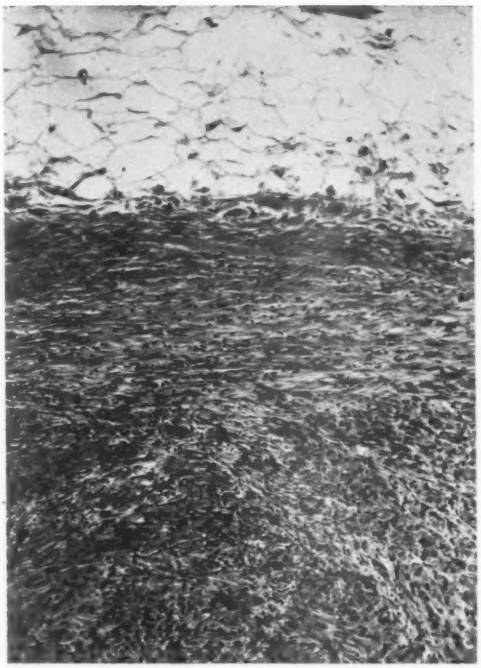

FIG. 1. Case 1. Granular cell myoblastoma of breast. Low power view showing tumor tissue clearly separated from subcutaneous fat above by fibrous capsule.

The patient's mother had died at the age of sixty-nine from carcinoma of the colon and metastasis to the liver. Two brothers were living and well.

Physical examination revealed a well nourished, well developed, apprehensive woman. A small freely movable non-tender mass was palpated in the inner lower quadrant of the left breast. There were no other irregularities. The mass was deep in the skin but superficial to the deep fascia, and it appeared to be within the limits of the breast tissue itself. A radiographic skeletal survey was negative. The rest of the physical examination and laboratory findings were within normal limits.

On April 12, 1954, the patient was taken to the operating room where, under anesthesia, the tumor was excised with a fairly wide ellipse of skin down through normal tissue with removal of some of the pectoral fascia. The tumor was a discrete homogenous mass slightly tan in color. (Fig. 3.) The pathologist was unable to make a diagnosis on frozen section, and he stated that this was not like any breast tumor he had ever seen. However, he raised the possibility of a metastatic lesion and recommended that further study be initiated to identify it. The operative site was then closed in the usual fashion.

The pathology report read as follows:

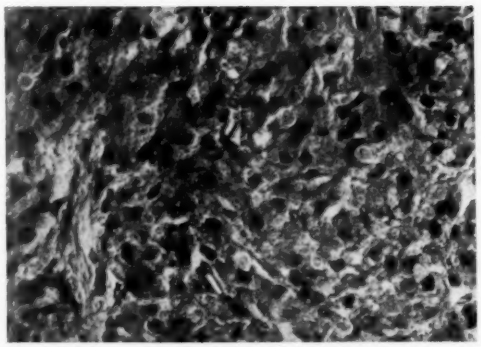

FIG. 2. Case 1. High power view of tumor showing granular round and ovoid cells.

"Specimen is an elliptical mass of skin and subcutaneous tissue removed from the lower inner quadrant of the left breast. The covering strip of skin measures approximately 4 cm. in length and up to 12 mm. in width; the underlying layer of fat tissue measures up to 4 cm. in thickness. At a distance of approximately 2 cm. below the skin, the fat tissue contains a fairly well demarcated, firm, cream-colored nodule measuring approximately 9 to 12 mm. in diameter.

"Sections show the nodule grossly described to represent a well demarcated although not encapsulated tumor (Fig. 4) composed of solid alveolar groups of cells separated by narrow fibrous trabeculae. The cells are large and are characterized by abundant cytoplasm which is generally eosinophilic and distinctively granular. (Fig. 5.) The nuclei are relatively small in size and uniform in appearance and chromatin structure; there are no significant features of atypism such as variability in

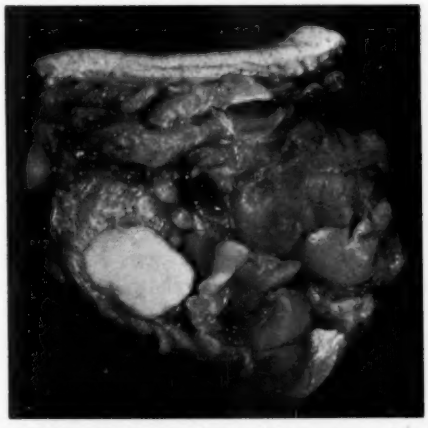

FIG. 3. Case 11. Photograph of excised specimen showing 1 cm. mass in fatty tissue of breast.

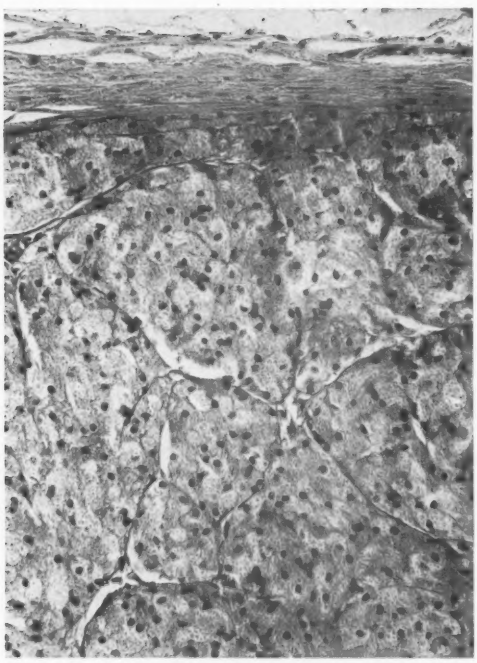

FIG. 4. Case 11. Granular cell myoblastoma. Low power view showing tumor and fibrous capsule. Groups of alveolar tumor cells are separated by fibrous trabeculae.

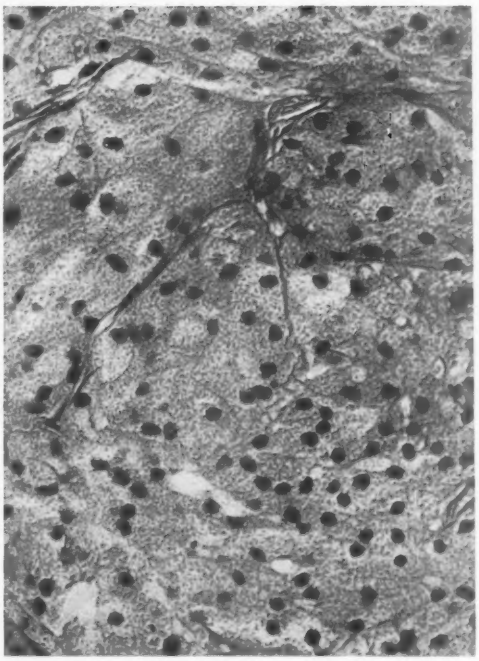

FIG. 5. Case 11. High power view of tumor showing large granular cells with abundant cytoplasm and regular round small nuclei.

size, irregularity in shape, hyperchromatism and mitotic figures. Although there is no true capsule, there is some tendency to perifocal fibrous condensation in places. In other areas directly adjoining the tumor, sections show typical collagenous breast stroma containing lobules of breast acini and ducts. The diagnosis is 'granular cell myoblastoma of breast.'"

COMMENTS

Since Abrikossoff [*1*] first reported these tumors in 1926, several hundred have been discussed in the literature [*6,16*].

They are found in diverse regions, but about fifty per cent are seen in the domain of otolaryngology. They usually appear in the striated musculature of the tongue; however, they have been seen occasionally in the maxilla, mandible, oral cavity, ear, and rarely in the vocal cords, trachea, bronchus or orbit [*13,19*]. The next most common group appears in the skin and subcutaneous tissue of various parts of the body ranging from the scalp to the heel and including the perianal region. The striated muscular structures of the body, apart from the tongue, form another group: the upper and lower extremities, chest, abdominal wall, back, and even the myocardium [*21*]. The urogenital tract is rarely involved, and isolated tumors have been found in the bile ducts, gastrointestinal tract and (questionable ones) in the pituitary stalk [*12*].

These growths may rarely be multiple, and one case of a patient who had forty-six separate lesions has been reported [*2*].

Occurrence in the Breast. About 6 to 7 per cent of these tumors appear in the region of the breast where they may be confused with carcinoma. To the best of my knowledge, twenty-five cases have been reported to date [*5,14,16*].

They are usually small masses (1 to 3 cm.), but occasionally they may be large (9 cm.) [*11*]. Often they are attached to the skin or underlying fascia and may cause dimpling of the skin. As a rule they are present on the medial side of the breast, but they have been reported in the outer quadrants.

Treatment is local excision, but we must not ignore the fact that approximately ten of the extramammary cases have been malignant with spread to regional lymph nodes, lungs, liver and bones [9,20]. One case of metastasis to the brain has been reported [22]. A case of myoblastoma of the breast reported by Crawford and De Bakey [7] metastasized to the lung and liver.

Origin of the Tumor. The origin of this tumor is still shrouded in mystery. One chain of reasoning has been based on morphologic evidence. Since Abrikossoff's first cases were in skeletal muscle and resembled embryonic myoblasts, he believed that they were derived from striated muscle cells. Many other authors have confirmed this opinion. The cells have a granular cytoplasm like myoblasts and the granules may appear in rows like young myofibrils. Some of the cells have cross and longitudinal striations. Limiting membranes are frequently absent, giving a syncytial formation. There are apparent transitional forms between muscle cells and tumor cells.

Murray's [17] cultures of such tumors should be mentioned since she believed that on culturing they grow out into forms which resemble cultures of various forms of skeletal muscle rather than any other type of tissue.

How can one explain such tumors in the breast where striated muscle is not normally found? Abrissokoff accepted the fact that they are probably embryonic rests. However, this reasoning is probably not necessary, since striated muscle does occur in abnormal locations. Haagensen and Stout [11] explained their presence in the breast as originating from either the rare sternalis muscle or from the lowermost fibers of the platysma.

However, just as many pathologists doubt that the cells look like myoblasts [8,10]. The cross fibrils can be interpreted as the cell membranes of closely interwoven cells and fine reticulin fibers from frayed collagenous stroma lying behind the cells [18].

What of the nerve pattern of these tumors? It has been demonstrated by Fust and Custer [8] and verified by other observers (notably Bangle [5] and Pearse [18]) that nerve twigs lying well beyond the limits of the masses may contain large cells with granular cytoplasm indistinguishable from the tumor cells. At the margins of many of the tumors, finger-like projections may be present centering about a bundle of axis cylinders. On cross section one may see a whorl of granular cells centering about a core of axis cylinders. Certain tumors display a general pattern reminiscent of peripheral nerve tumors with the cells arranged in fasciculi and separated by wavy fibrils. However, evidence against the nerve origin has been presented by Pearse who revealed that the nerve fibers are myelinated and not naked axis cylinders which are usually present in neurinomas and neurofibromas.

The collagen pattern has interested many pathologists. Pearse [18], for instance, has found that the collagen breaks down around the cells. There is a "brush" of reticulin fibers which may be formed at both poles of isolated myoblastoma cells. In some areas, the fine reticulin network surrounding the cells stains metachromatically with toluidin blue which suggests that it is composed of young actively growing fibrous tissue.

Special stains with periodic acid-Schiff and Sudan black have revealed more than the normal amount of fibroblasts in the stroma. Such cells may contain granules in the cytoplasm at the poles of the nucleus which stain positively with periodic acid-Schiff. Intermediate forms between these and granular tumor cells can be observed.

There is a close resemblance between the nucleus of the young fibroblast and the younger granular cell, but this is not characteristic. Thus there is strong evidence along morphologic lines that these cells are derived from some type of fibroblast.

Histochemical studies of the granules would be expected to be of help in solving the problem. Extensive studies have been performed by Azzopardi [4], Bangle [5] and Pearse [18]. Since the granules do not contain glycogen, this would tend to rule out the muscle origin of the cells. However, they do contain lipoid and protein. They do not resemble normal myelin either chemically or physically.

Thus, we find that the origin of these cells is still in dispute, but there is much evidence suggesting that they arise from fibroblasts, which suggests possible implication of both peri- and endoneural fibroblasts.

SUMMARY

Two cases of a very rare tumor, granular cell myoblastoma, in the breast are reported. These tumors are of doubtful lineage but recent evi-

dence implies they are derived from fibroblasts. Since they mimic carcinoma on frozen section, surgeons and their pathologists should be aware of them.

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Acute Non-calculous Cholecystitis in Children

REPORT OF A CASE IN A SEVENTEEN DAY OLD INFANT

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SINCE the first case report of cholecystitis in a child by Gibson in 1722, 426 cases were found by Potter up to 1938 [23]. Ulin et al. [30] added sufficient cases to make the total 475 up to 1948, considering only 326 cases well documented enough to be "proved cases." Of 226 cases reported up to 1928, only two were of acute cholecystitis without stones in infants, the subject of the present paper [22].

Hasson's case report in 1835 is the first report quoted by Potter [22] of acute, non-calculous cholecystitis in a child, associated with typhoid fever and confirmed by autopsy. Potter credits Houze in 1922 as being the first to treat a patient with acute non-calculous gangrenous cholecystitis by cholecystectomy; the patient was a five year old child.

CASE REPORT

B. D., a white, full term, male infant was first seen at the age of seventeen days as an outpatient on November 28, 1956, with a one-day history of crying and loss of appetite. Delivery had been normal and birth weight was 8 pounds, 3 ounces. The infant had not been a feeding problem other than seeming to be "hungry all the time." The mother believed that the child had had a slight fever on November 27, and had noted a reduced number of yellowish stools in the few days prior to November 28.

Past and family history revealed that the mother had had an episode of sinusitis during the last trimester of pregnancy. This was of short duration but associated with an elevation in temperature. At eight and a half months gestation the mother had a gastrointestinal upset with vomiting, diarrhea and an elevation in temperature of 101°F.

The infant was believed to be a feeding problem and to have mild pharyngitis for which an antibiotic was prescribed.

By late evening, the crying seemed worse and the infant was noted to draw up his knees "acting like his stomach was hurting." Paregoric, was administered, followed by sleep; however, on awakening, the infant's symptoms appeared to be of greater severity. An enema seemed to provide some relief.

On November 29, the infant had a temperature of 102°F., was crying and irritable, and abdominal distention was noted. Generalized tenderness was present with muscle spasm and a 1.0 to 1.5 cm. palpable mass in the right upper quadrant. No bowel sounds were audible.

The working diagnosis at this time was acute appendicitis, with the possibility of acute cholecystitis and volvulus excluded.

White blood count was 15,200 per cu. mm.; band neutrophils, 5 per cent; segmented neutrophils, 59 per cent; lymphocytes, 30 per cent; monocytes, 6 per cent. A flat plate of the abdomen was interpreted as "paralytic ileus."

At operation, a markedly distended, grossly gangrenous gallbladder was removed. No anomaly of the cystic or common duct was present. A small sound was passed through the cystic duct stump into the common duct and duodenum. The lumen of the removed gallbladder contained free pus and a moderate amount of green bile. Culture revealed the presence of Escherichia coli, sensitive to all tetracyclines.

An uneventful postoperative course followed with the return of temperature to normal by the fourth postoperative day. The child was last seen at sixteen months of age, appearing normal and healthy in every respect.

INCIDENCE

Little need be added to the figures in the first paragraph of this report to impress the reader with the infrequency of this condition. In a survey of 3,222 cholecystectomies, only seven were in patients below the age of fifteen years; two of which had cholelithiasis in addition, and only one being beneath one year

of age. The pathologic condition in this last patient was acute cholecystitis without cholelithiasis [10].

Of 3,000 operations of the biliary tract at Harper Hospital, Detroit, up to 1940, six were in patients below the age of fifteen years; only one of which was for acute cholecystitis not associated with cholelithiasis [3].

Gallbladder disease attacks male children in greater ratio than male adults [31] but follows much the same race distribution in children as in adults with the Negro race affected far less frequently than the white [6,16,22]. Cholelithiasis occurs more frequently in children than does cholecystitis [1] and acute cholecystitis is believed by some to occur less frequently in infants than older children [21].

It is probable that the already low incidence of gallbladder disease in children is decreasing due to the appearance and use of antimicrobial agents which arrest illness in advance of complications such as acute cholecystitis [5,16].

ETIOLOGY

Ulin stated that "the general trend of information collected seems to indicate that infection, locally and systemic, plays a more important part in childhood cholecystitis than in that of an adult" [31]. Potter listed typhoid, influenza, diphtheria, appendicitis, scarlet fever, infections of the digestive tract and emptying anomalies as causes of cholecystitis [22]. Cases associated with hemolytic streptococcal septicemia, acute glomerulonephritis, erysipelas and salmonella oranienburg have been reported [10].

Public health measures and antibiotics will probably prevent another author from reporting eighteen cases of typhoid fever with gallbladder complications as did Reid in 1920 [24].

Kahle and Jackson [16] reported on a Negro child with cholecystitis occurring in association with intestinal parasites, not identified in the gallbladder contents; however, E. coli was cultured. Forshall and Rickham describe stenosis of the cystic duct in their case of acute gangrenous cholecystitis [7].

Although scarlet fever has been implicated in the etiology of cholecystitis in children, a survey of over 12,000 cases of this disease revealed only two cases of acute cholecystitis [27].

On the basis of experimental work in 1942, Womack and Bricker [33] stated "It seems apparent that interference with the ability of the gallbladder to empty itself adequately is concerned with the production of cholecystitis. Yet obstruction alone is not sufficient." Three factors in the production of acute gallbladder disease were recorded to which a fourth was added a decade later: (1) obstruction of the cystic duct, (2) action of concentrated bile within the gallbladder, (3) impairment of the blood supply of the gallbladder, and (4) occasional secondary development of bacterial infection which would be superimposed on chemically damaged tissue [29,33].

Bonta et al. [5] divided the pathogenesis of gallbladder disease by age groups thusly:

1. Neonatal period and infancy: congenital deformities of the biliary tract.
2. Early childhood: infections.
3. Late adolescence and adulthood: intimately associated with and frequently secondary to cholelithiasis.

In Table 1 of cases of acute non-calculous cholecystitis in children reported since 1928, associated factors possibly related to etiology are listed.

One additional point bears mentioning. Ahrens [1] notes that in a series of autopsies on malnourished Chilean infants, histologic findings interpreted as cholecystitis were observed in 35 per cent.

DIAGNOSIS

The chief diagnostic difficulty in children is that the disease, because it is infrequent, is seldom remembered [16]. The failure of authors in a recent symposium on pediatric abdominal disease to mention cholecystitis and cholelithiasis as a cause of jaundice or vomiting lends weight to this statement [8,15].

Gastrointestinal upset, nausea, vomiting and constipation are symptoms of greatest frequency of cholecystitis in children. Abdominal pain, which is also frequent, may have vague localization. Jaundice is present more often in children than in adults, but stones less so [1].

Diarrhea and colic are reported symptoms. A history of indigestion, flatulence and food intolerance is seldom obtainable. Elevation in temperature and leukocytosis are frequent findings. Localized rigidity, spasm, tenderness and even a palpable mass may be present. The location and nature of the tenderness is responsible for the common initial diagnosis of high lying acute appendicitis.

TABLE 1

ACUTE NON-CALCULOUS CHOLECYSTITIS

Author	Age (yr.) and Sex of Patient	Possible Etiologic Factor
Montgomery, 1932	6, F	Hemolytic streptococci
Holbrook, 1934	11, M	E. coli; proteus
Lowenburg and Mitchell, 1938	11, M	Bilateral otitis media
Sobel, 1938	6, F	Prior jaundice
Ashley and Narotzky, 1941	4, F	Upper respiratory infection
Tempest, 1950	4, M	Stool culture showed E. coli
Gibbon, 1952	20 mo., F	None recorded
Bonta and Lovingood, 1952	4, F	Acute otitis media, salmonella oranienburg
Lee and Englender, 1953	7, M	Febrile upper respiratory infection; ascariasis one month prior to being seen by a physician
Kahle and Jackson, 1953	6, F	Ascariasis; E. coli
Glenn and Hill, 1954	15, M	None recorded
Forshall and Rickham, 1954	2½, F	Congenital stenosis of cystic duct
Hopmans, 1955	6, F	Pneumonitis of the lower lobe of the right lung
Webb, 1956	7, M	Sore throat for one week
Ahrens [2], 1957	8, M	Meningitis; multiple intestinal parasites
McGahan and Whittinghill, 1956	3½, M	Possible infectious hepatitis

A source of diagnostic aid may be duodenal drainage or x-ray film. If time and symptoms allow, good visualization of the gallbladder in infants from nine to eleven months of age may be obtained by modified technics. [*11,14*].

In considering the possible diagnosis of acute cholecystitis, appendicitis, infectious hepatitis, intestinal obstruction, pneumonia, renal disease, pancreatitis, perforated viscus and pericarditis are a few of the entities which should be ruled out [*1*].

TREATMENT

Definitive treatment is dictated by the clinical picture. Surgery must be resorted to as indicated and when necessary, keeping in mind a few statistics compiled by Ulin for purposes of diagnosis as well as treatment.

Of 326 cases, 222 or 68 per cent were associated with cholelithiasis; in only nineteen or 6 per cent were stones found in the common duct; carcinoma of the gallbladder occurred in only two cases [*30*].

COMMENTS

The patient reported on herein is believed to be the youngest patient ever treated by cholecystectomy. However, the case of a two day old infant treated by cholecystostomy has been quoted by Ulin [*31*].

Many of the papers reviewed allude to the misdiagnoses in gallbladder disease in children. It is believed that greater consideration of this entity in the differential diagnosis of abdominal discomfort will result more often in accurate diagnosis and correct treatment.

Certain differences between gallbladder disease in adults and children are apparent. (1) In children: the major percentage of acute cholecystitis is associated with acute systemic disease; (2) cholelithiasis and particularly choledocholithiasis are infrequent, hence jaundice is not a great indication for exploration of the common duct [*10*]; (3) stones are usually of the pigment variety [*25*]; (4) history of chronic dyspepsia is not common; (5) there is a male preponderance; (6) bacterial identification is more frequent; and (7) associated malignancy is less frequent [*1,31*].

SUMMARY

1. Acute non-calculous cholecystitis occurs infrequently in children.

2. Gallbladder disease in children involves males in greater ratio than females; stones occur less frequently.

3. The correct diagnosis is usually not made until operation.

4. Acute systemic infectious disease is frequently associated.

5. A case of acute gangrenous cholecystitis

in a seventeen day old infant treated by cholecystectomy is reported.

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Immediate and Delayed Rupture of the Extrahepatic Biliary Tract Following Blunt Abdominal Trauma

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RUPTURE of the extrahepatic biliary tract following blunt abdominal trauma is uncommon. Delayed rupture is seen even less frequently. Recently at the Cook County Hospital we have encountered three cases of rupture of the extrahepatic biliary tract following blunt abdominal trauma.

CASE REPORTS

CASE 1. R. S. (No. 33,230), a fifty year old white man, was admitted to the surgical service on May 16, 1958, at 9 A.M. He had been awakened at 5 A.M. on the day of admission with knife-like periumbilical pain which radiated to the substernal area, and was aggravated by coughing or straining. The pain persisted throughout the day, gradually increasing in severity, and shortly before admission he had vomited some clear gastric contents following intake of a glass of water.

The patient had a history of moderate alcoholism, but denied having had previous abdominal pain or digestive disturbance. No history of trauma was obtained initially, but further questioning after surgery revealed that he had accidently been struck in the right upper part of the abdomen with a crowbar three weeks previously. He was knocked down and became "unconscious" momentarily, but he believed the injury to be insignificant and had remained free of symptoms until the day of admission.

Physical examination revealed a well developed white man in acute distress with abdominal pain. Temperature was 99.6°F., pulse, 88 per minute; blood pressure, 120/80 mm. Hg; and respirations, 20 per minute. Positive findings were limited to the abdomen which was semi-rigid throughout with maximum tenderness in the epigastrium and right upper quadrant. Bowel sounds were not audible, and no masses were palpated. Rectal examination with benzidine revealed normal stool, and palpation disclosed no masses or tenderness.

Laboratory studies demonstrated a moderate albuminuria and no evidence of bile or sugar. Hematocrit was 44 per cent and serum amylase determination was within normal limits. Roentgenograms revealed gaseous distention of the small bowel, stomach and colon with no free air and an early stage of pneumonitis in the upper lobe of the right lung.

The diagnosis of acute appendicitis or perforated ulcer with paracolic spill was made, and with the patient under general anesthesia the abdomen was explored through a right paramedian incision. The peritoneal cavity was free from adhesions, appendix was normal, and a small amount of bile-stained fluid was present in the free cavity. However, the right paracolic gutter was markedly dis ended with bile-stained fluid, and on reflecting the right colon, 500 to 700 cc. of pure bile was found free in the retroperitoneal tissues. The bile had diffused the gastrohepatic ligament and over the surface of the gallbladder and had also stained the descending duodenum. The medial half of the gallbladder was hidden by a natural fold of peritoneum between it and the duodenum and hepatic flexure of the colon. A rent was discovered in the anteromedial wall of the gallbladder with bile leaking freely into what had been the retroperitoneal space. Cholecystectomy was performed, and because no stones were present and the cystic duct appeared normal, it was deemed necessary to explore the common bile duct. This duct was normal and a No. 8 Bakes dilator was easily passed through the papilla. A small T-tube was inserted into the common duct and a Penrose drain inserted in Morison's pouch. The postoperative course was uneventful, and the patient was discharged on the tenth postoperative day after a T-tube cholangiogram revealed a normal common duct.

Pathologic report stated the gallbladder was free from calculi and had a 1.3 cm. tear in the anteromedial wall. Microscopic section taken from the site of rupture revealed an absence of mucosa with necrosis and hemorrhage compatible with rupture of the gallbladder.

CASE II. W. L., (No. 54,571), a forty-seven year old white male laborer, was admitted August 11, 1958, because of abdominal pain. He had been drinking heavily ten days prior to admission. Eight days before admission he received multiple, nonpenetrating blows to the chest and abdomen in a dispute. Three days before admission while arising from bed, he suddenly experienced severe generalized and non-radiating abdominal pain which persisted. He vomited several times during the twenty-four hours preceding admission.

Past history revealed a hospital admission in February 1957 for jaundice and a readmission in July 1957 for splenectomy following blunt trauma. He had a thirty-year history of chronic alcoholism.

Physical examination revealed a pale white man with tremors of the hands and impending delirium tremens. Rectal temperature was 99°F.; blood pressure, 110/80 mm. Hg; and pulse, 120 per minute. Icterus of the sclera and angiomata of the skin of the abdomen were present. There was a contusion of the left lower anterior part of the chest wall. The abdomen was distended, with diffuse tenderness and rebound, and was without bowel sounds. Diagnostic paracentesis in the right lower quadrant showed dark greenish brown peritoneal fluid.

Laboratory studies were as follows: hematocrit, 34 per cent; urine amylase, 64 units; and serum amylase, 32 units. Icteric index was 40 units; cephalin flocculation, 3 plus; and gamma globulin, 1.94 gm. per cent. Urinalysis demonstrated a 2 plus albumin, bile and urobilinogin. Roentgenograms revealed a distended large and small bowel with no free air.

Twelve hours after admission the patient underwent exploratory laparotomy performed through a right paramedian incision. The findings were a perforation in the dome of the gallbladder and approximately 400 cc. of bile in the abdominal cavity. Cholecystectomy was performed and two Penrose drains were inserted into Morison's pouch. The postoperative course was complicated by pneumonia, delirium tremors and a wound infection, but the patient was discharged on August 27, 1958.

The pathologic report of the gallbladder was as follows: The specimen was 9 cm. in length with a ragged defect 1.5 cm. in length on the anterolateral wall. Microscopic section taken from the site of rupture revealed absence of mucosa, with necrosis and hemorrhage in the wall compatible with rupture of the gallbladder.

CASE III. D. S., (No. 49,472), a forty-two year old white man, was admitted July 23, 1958, after having received a kick in the abdomen during a dispute eight hours before admission. He had consumed a large quantity of alcohol prior to and following the dispute. After consuming a glass of wine, the abdominal pain increased and he vomited. The patient was then brought to the hospital.

Past history was non-contributory. Physical examination revealed an acutely ill white man who complained of severe generalized abdominal pain. Blood pressure was 110/65 mm. Hg; pulse, 98 per minute; and temperature, 99°F. The abdomen was rigid with generalized tenderness, and no masses were palpated. Bowel sounds were absent.

Laboratory studies revealed a hematocrit of 50 per cent. Urinalysis was negative for abnormalities, and roentgenograms of the abdomen revealed no free air.

Exploratory laparotomy ten hours after the dispute was performed through a right paramedian incision, revealing 300 cc. of free bile in the abdominal cavity. The gallbladder was edematous and markedly distended, and the common bile duct near the entrance of the cystic duct was edematous and covered with green fibrinous material. This was apparently the site of perforation which had sealed at the time of surgery. The liver, stomach, retroperitoneal duodenum and small bowel were free from injury. Cholecystectomy was performed, and a No. 14 T-tube inserted into the common bile duct. Irrigation with saline solution using the T-tube failed to reveal a defect of the duct. Two Penrose drains were inserted into Morison's pouch through a stab incision. The postoperative course was uneventful, and the T-tube was removed on the twelfth day after a negative cholangiogram was obtained.

Pathologic report stated that the gallbladder was free from stones or perforation. Microscopic sections revealed sheets of polymorphonuclear leukocytes in the serosa and pericholecystitis with coarsened mucosal folds lined by tall columnar epithelium.

COMMENTS

While practically all abdominal viscera have been variously indicated in case reports of blunt abdominal trauma, the extrahepatic biliary tract has had a significant, if only partial, immunity. The surrounding liver, kidney and costal arch combine with a recessed location along the vertebral bodies to provide a bony and visceral cushion which few other intra-abdominal structures have.

Such protection is occasionally inadequate as attested by periodic case reports dealing with rupture of the extrahepatic biliary system secondary to non-penetrating injuries. While the latter is decidedly uncommon, the occurrence of delayed rupture following such trauma is indeed rare.

Smith et al. [*10*] in 1956 reviewed the literature and collected twenty-six cases of rupture of the extrahepatic biliary tract to which he added a personal case. Isolated case reports have appeared since then [*7,9*]. One of several important points emphasized by these authors is that in a number of cases, the actual site of perforation cannot be demonstrated. Burchardt [*1*] in 1923 suggested that a minute perforation permitted escape of bile under tension, and this perforation could not be found or had closed. One of Cope's [*3*] patients was a twelve year old boy who was knocked down by an automobile and treated in the hospital two days for abdominal pain. He was discharged only to be readmitted two weeks following the accident with abdominal rigidity. Surgery disclosed an undetermined perforation in the region of the junction of the hepatic, cystic and common bile ducts which was the site of soft inflammatory infiltration. The site of perforation in Case III undoubtedly involved the common bile duct even though instillation of saline solution through the T-tube failed to reveal it.

No free air is noted on x-ray film unless rupture of the biliary tract is associated with other injuries involving a perforated stomach or bowel. This has not been reported. The bile-stained fluid on diagnostic paracentesis is suggestive but can occur with perforations of the proximal foregut or, rarely, in acute pancreatitis. A negative paracentesis may be misleading if the rupture is retroperitoneal.

Cohen et al. [*2*] and others [*5,6*] state that perforation of the gallbladder complicating calculous cholecystitis is frequently accompanied by peritoneal and gastrointestinal hemorrhage. This has not been seen when blunt trauma was the etiologic agent and gallstones were usually not encountered. It would appear that trauma could more easily rupture a normal thin-walled gallbladder than a thickened fibrotic-walled viscus which is the site of chronic inflammation.

Management of patients with traumatic extrahepatic perforation of the biliary tract who have a history of trauma depends upon the site and type of injury. If the laceration involves the common bile duct, primary repair should be attempted with a T-tube drain inserted distal or proximal to the laceration. Donald et al. [*4*] reported a case of complete severance of the common bile duct repaired eight days following the injury. In those cases in which no definite perforation is identified, irrigation of the common bile duct through a T-tube may aid in locating the perforation. If it is not found, T-tube decompression and cholecystectomy should suffice.

SUMMARY

Three cases of perforation of the extrahepatic biliary tract due to blunt abdominal trauma are presented.

Etiology, diagnosis and management are discussed.

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Recurrent Tracheoesophageal Fistula

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THE literature of recent years has contained numerous reports of successful surgical repair of tracheoesophageal fistula. The majority of cases are associated with esophageal atresia, only four patients in Gross' [2] series not having associated atresia ("H" type of tracheoesophageal fistula). There have been very few cases of recurrent tracheoesophageal fistula following initial repair and in many of the larger series, this complication is not reported. The few cases reported were recognized in the early postoperative period and apparently a striking clinical change in the patient lead to recognition of the condition. Lyon and Johnson [6] in 1948 reported a recurrent fistula occurring on the fourth postoperative day. Bigger [1] in 1949 reported on one child who died seven months after initial surgery for recurrent fistula. Potts' [7] series of thirty-five cases reported in 1950 made no mention of recurrent fistula. In Gross' [2] extensive experience, recurrence was never mentioned although he states that difficulties in swallowing, coughing and recurrent attacks of pneumonitis plague this field of surgery. Hewlett [3] in 1955 reported a case of recurrent tracheoesophageal fistula which was successfully repaired twenty-two and a half months after initial repair. At that time he found only four other cases of recurrent fistula in the literature. Fatality rate following operation for recurrent fistula has been extremely high, approaching 50 per cent.

The rarity of recurrence of tracheoesophageal fistula following primary repair leads us to report the following case of successful repair of a recurrent fistula twenty-three months after initial operation.

CASE REPORT

A twenty-two month old white male infant was admitted to the Surgical Service of Tripler U. S. Army Hospital on October 27, 1958, for diagnostic studies because of recurrent episodes of pneumonitis. He was born at an Army station hospital on December 15, 1956. The mother was eighteen years old, gravida 1, para 0. Her pregnancy was uneventful and delivery was precipitous. The patient's birth weight was 6 pounds, 4 ounces. Excessive salivation and abdominal distention were noted. X-ray films of the chest revealed atelectasis and pneumonia of the upper lobe of the right lung, and a lipiodal swallow as well as a barium enema demonstrated no abnormalities. The infant had then been transferred to a general hospital where a diagnosis of "H" type tracheoesophageal fistula was made. At the age of six days, the child underwent thoracotomy with repair of the "H" type tracheoesophageal fistula. He had an uneventful postoperative course until twenty days after surgery when he vomited, became dyspneic and had recurrence of abdominal distention. X-ray films were obtained which revealed pneumonia of the upper lobe of the right lung and after two to three days of administration of antibiotics his condition improved. Subsequently, there were repeated episodes of coughing, vomiting and abdominal distention at ten- to fourteen-day intervals. All of these responded to treatment of antibiotics, intravenous fluids and aspiration. The possibility of a recurrent tracheoesophageal fistula was considered but all studies, including esophagograms and bronchoscopy, revealed no abnormalities. Because of recurrent attacks of vomiting, dyspnea and cyanosis, gastrostomy was performed on February 22, 1957. Subsequent feedings were uneventful, and except for one episode of cyanosis, flaccidity and pulse elevation to 200 which occurred on March 12, and responded to digitalis therapy, the child had no further episodes of coughing, vomiting and abdominal distention. Laboratory tests for mucoviscidosis were negative. On April 2 the gastrostomy was closed, and on May 6 the child was discharged to his parents' care.

He was admitted to a university hospital on July 3 with a twenty-four–hour history of cough, vomiting and fever. His weight was 4.38 kg. Physical examination revealed the previous surgical scars; respiratory rate, 45 per minute; pulse, 150

per minute; rales throughout the lung fields; and cyanosis. The remainder of the physical examination was within normal limits. X-ray films were interpreted as showing an aspiration pneumonia. Treatment consisted of intravenous fluids, oxygen and antibiotics. Three esophagograms were performed and considered within normal limits. He was discharged on September 4, weighing 4.75 kg.

On March 7, 1958, the child was first admitted to Tripler U. S. Army Hospital Pediatric Service because of respiratory distress, cough, vomiting and fever. A diagnosis of interstitial pneumonitis was made on the basis of roentgenographic and physical findings. He responded to treatment with oxygen and antibiotics and was discharged on March 19. At this time, repeated x-ray films of the chest revealed persistent perihilar pneumonitis. The child's weight on discharge was 16 pounds, 3 ounces.

He was readmitted to Tripler U. S. Army Hospital on May 18 with similar history and physical findings, and after treatment for pneumonitis was discharged on May 22, weighing 16 pounds, 11 ounces.

On May 25 he was admitted for the third time, and after pneumonitis had cleared, diagnostic studies were performed. Esophagogram revealed no abnormalities. Bronchography was performed with the patient under general anesthesia on July 24 and, except for atelectasis of the middle lobe of the right lung, was within normal limits. There was no evidence of a tracheoesophageal fistula. Tests for mucoviscidosis were negative. The child was then discharged on July 26 with a diagnosis of recurrent pneumonitis. He again was admitted on September 6 but was discharged the next day without any treatment.

He was subsequently readmitted to the Surgical Service of the hospital on October 27 for evaluation of recurrent pneumonitis. An esophagogram performed while an outpatient on September 26 showed spillage of the Gastrografin® into the tracheobronchial tree but no fistula could be demonstrated. Except for excessive salivation and repeated episodes of coughing and vomiting, poor appetite and weight gain, the history was within normal limits. Physical examination revealed no abnormalities except for previous surgical scars, malnutrition and coarse rhonchi throughout both lung fields. Laboratory data were normal except for hemoglobin, 11.5 gm. per cent; and hematocrit, 38 per cent.

On October 31 bronchoscopy was performed with the child under general anesthesia. No fistula could be seen; however, excessive amounts of bronchial secretions were noted. Severe respiratory distress then developed with cyanosis and substernal and intercostal retraction with breathing. He was started on antibiotics and oxygen and transferred to the Pediatric Service for treatment of pneumonitis. He responded to treatment and subsequently was returned to the Surgical Service for surgery. Although a definite diagnosis of recurrent tracheoesophageal fistula could not be proved by x-ray studies or bronchoscopy, clinically it was believed to be the cause of the recurrent attacks of pneumonia, and thoracotomy was performed on November 14.

At operation, the chest was entered through the third interspace, excising the old scar. Dissection revealed the old suture line and a small fistulous tract at this level between the esophagus and trachea. It was noted that as the anesthetist controlled respirations, the esophagus would distend with air much like inflating a balloon. The fistula was divided and the esophagus collapsed, remaining so. Openings of the tract were closed with No. 4–0 silk sutures in two layers, and mediastinal pleura was placed so as to separate the two suture lines. The lung then was reinflated, repair checked by pouring saline into the thoracic cavity and when air-tight repair was proved, the chest was closed with a multi-holed catheter in place for water-seal drainage.

Postoperatively, intravenous feedings were maintained for forty-eight hours. At that time an esophagogram was performed which showed no evidence of spillage into the trachea. The patient was then started on fluids by mouth and progressed to a regular diet which he tolerated well. Antibiotics were continued for seven days. The chest tube was removed on the sixth postoperative day and skin sutures on the seventh postoperative day. Repeat films of the chest were taken which revealed that the chronic inflammatory process in the lungs was clearing. He was discharged on November 26 (twelve days postoperatively), weighing 20 pounds. The patient was seen subsequently on December 5 and continued to do well. He then weighed 21 pounds which was the heaviest he had ever been. He was eating well, his appetite was tremendous and there were no further episodes of coughing and vomiting with his feedings. He has been followed up for more than one year postoperatively and has had no further respiratory difficulties.

COMMENTS

It is apparent by history that the patient had a recurrence of the fistula during his postoperative course. Although it was suspected, actual presence of the fistula could not be demonstrated. Several factors may lead to the re-establishment of a fistula: (1) a leaking esophageal suture line with direct extension into the site of the tracheal closure; (2) direct contact between the esophageal and tracheal suture lines; (3) mechanical trauma resulting from early postoperative dilatation of the esophagus.

The contiguous position of the suture lines and a leak in the esophageal suture line appear

to have been the factors present in the recurrent fistula reported herein. The true pathologic condition was masked because of the response of respiratory difficulties to antibiotics. Although antibiotics probably kept the child alive, they also aided in substantiating the tentative diagnosis of recurrent pneumonitis. Repeated efforts to prove a tracheoesophageal fistula by x-ray studies and bronchoscopy were not successful, and it is understandable why it was believed that these were recurrent attacks of pneumonitis.

It is interesting to speculate whether the recurrent attacks of pneumonitis and difficulty in deglutition, which Gross [2] states are common in patients with postoperative tracheoesophageal fistula, are not really due to recurrence of the fistula without associated esophageal stenosis. Many accurate descriptions have been written dealing with the diagnosis of tracheoesophageal fistula with associated esophageal fistula. The existence of a fistula without esophageal stenosis or atresia is relatively uncommon and may be overlooked. Holt et al. [4] in 1946 and Leigh et al. [5] in 1951 wrote about the difficulties in diagnosing tracheoesophageal fistula without esophageal stenosis or atresia. Some cases have masqueraded under the diagnosis of faulty deglutition and recurrent pneumonitis. The authors have suggested the use of additional x-ray studies, not generally used in the evaluation of patients with suspected tracheoesophageal fistula, in order to demonstrate the fistula. It seems justifiable to include the studies in the diagnostic survey of any infant suffering repeated episodes of pneumonitis, especially in those with difficulty following surgery for tracheoesophageal fistula.

Literature on the operative technic for tracheoesophageal fistula has not stressed any particular point to prevent the recurrence of fistula. In the case presented herein, as well as that of Hewlett [3], interposition of a mediastinal flap between the suture lines may have prevented recurrence. The use of the interposed mediastinal flap should be a routine part of the operative procedure for repair of tracheoesophageal fistula.

SUMMARY

A case of recurrent tracheoesophageal fistula without associated esophageal stenosis is presented. Corrective surgery was performed twenty-three months after initial repair of a tracheoesophageal fistula. The rarity of the condition, the fact that it is amenable to surgery, and belief that many cases of recurrent pneumonitis and faulty deglutition following tracheoesophageal surgery in infants may well be due to small recurrent tracheoesophageal fistulas without esophageal stenosis, have compelled us to report our case.

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Mechanical Intestinal Obstruction As a Late Complication of Mucoviscidosis

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THE occurrence of a mechanical intestinal obstruction (meconium ileus) as a manifestation of mucoviscidosis in the newborn is well known. In 1951, Levy [1] suggested that the younger and more debilitated children are liable to this complication because older children with their more powerful intestinal peristalsis can propel the abnormal feces through the ileocecal valve.

The following is a most unusual case report of an eleven year old patient with known mucoviscidosis in whom a mechanical obstruction of the small intestine developed. The extreme rareness of this complication in this age group is evidenced by the absence of similar cases in medical literature.

CASE REPORT

Patient J. C. was first admitted to the pediatric service of The Brooklyn Hospital in 1952 when he was five years of age. The chief complaint on admission was abdominal distention associated with ten to fifteen bulky, foamy, foul bowel movements a day plus frequent colds and a dry, barking cough of two years' duration. Past history included a previous admission to a metropolitan hospital for rectal prolapse in 1950.

Physical examination revealed a poorly nourished, five year old Negro boy who weighed 27 pounds and was 39 inches tall. The only positive findings were a large, protuberant abdomen with the liver edge palpable 5 to 6 cm. below the right costal margin, and 2 plus edema of the ankles.

The laboratory findings on admission included: a total protein value of 5.6 gm. per cent; albumin, 2.72 gm. per cent and globulin, 2.88 gm. per cent; urea, 17 mg. per cent; calcium, 7.5 mg. per cent; alkaline phosphatase, 15.5 Bodansky units; and prothrombin time, 20 seconds with a control of 14 seconds. Trypsin activity in the stool was weakly positive in 1:5 dilution and negative in 1:10. There was moderate elevation of neutral fats and starches in the stools. Duodenal drainage revealed a low trypsin level of 2.5. A macrocytic normochromic anemia was also present. A roentgenogram of the chest showed mottled densities with bilateral "honeycombing" representing cystic changes. (Fig. 1.) Bone age of the hands and wrists, determined by roentgenograms was comparable to that of a male 2.9 years old. On the basis of these findings the diagnosis of cystic fibrosis of the pancreas and the lungs was made.

The patient was placed on a high protein, low fat, low carbohydrate diet. He was given parenteral liver, multivitamins, 1.5 gm. of pancreatin three times a day before meals and Aureomycin® [2]. The number of bowel movements then decreased

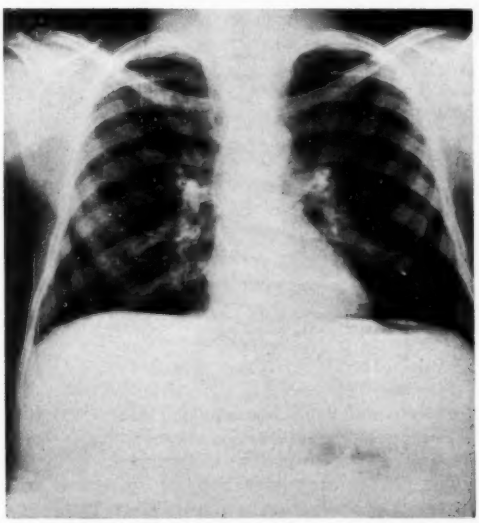


FIG. 1. Roentgenogram of chest shows changes of a moderate degree associated with mucoviscidosis. There are multiple small areas of atelectasis and emphysema depending on whether there is complete obstruction by viscid secretion or only a ball-valve type obstruction.

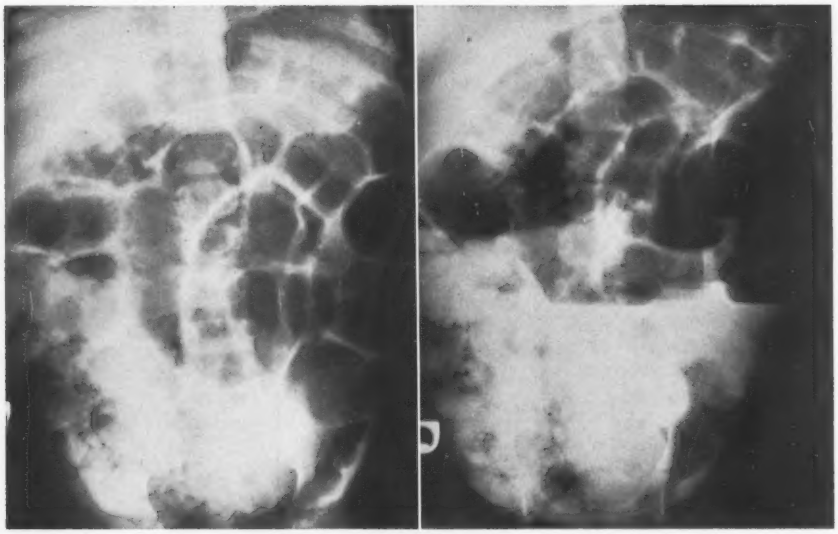


FIG. 2. Roentgenograms of abdomen show marked distention of small intestinal loops with air-fluid levels on upright view. Also, intestinal segments containing viscid material of meconium type causing obstruction fill right lower abdomen and pelvis.

markedly to three to four a day, and the child gained 10 pounds in a period of eighty days in the hospital.

The patient was discharged on the aforementioned regimen and examined in our pediatric clinic at regular intervals until May 1957. During this period, the child had been troubled by a chronic cough and a low grade fever.

After an absence of one year, the patient returned to the clinic. He was again admitted to the hospital because of bilateral bronchopneumonia from which he promptly recovered. At this time, he complained also of occasional abdominal pain in the right lower quadrant and stated that he had not taken his pancreatin or followed his diet during the past year. The patient was discharged improved after five days.

The patient was admitted to the Brooklyn Hospital for the third time on May 12, 1958, with the complaint of severe abdominal pain and constipation of two days' duration.

Physical examination revealed a distended abdomen and a hard abdominal mass extending from the subcostal area down to the right iliac fossa. Peristaltic sounds were markedly increased.

The patient was given nothing by mouth, and intravenous fluids were administered. Colonic and Harris irrigations were administered which were productive of some flatus, gray-white membranes and a little blood.

During the next three days the abdomen became more distended and the patient began vomiting. A flat film of the abdomen revealed obstruction of the small bowel most likely at the terminal jejunum with the ileum filled with a large amount of fecal material. (Fig. 2.)

A Miller-Abbott tube was inserted and the patient was taken to the operating room where a Mikulicz resection and double ileostomy were performed [3]. At operation a putty-like, thick tenacious material was found obstructing the distal 50 cm. of the terminal ileum up to the ileocecal valve. The proximal ileum and jejunum were markedly dilated and contained a large amount of fluid and gas. The cecum and ascending colon were empty.

During the next few days the distal ileostomy loop was irrigated with pancreatin solution to free the tenacious material. This was followed by irrigation with a 3 per cent solution of hydrogen peroxide.

The pathologic report of the resected ileum disclosed that the lumen was completely obstructed by a hard, greyish material and thick mucus. (Fig. 3.) Microscopically, the mucosa showed excessive secretion of mucus with prominent large goblet cells and crypts distended by mucus, while the entire inner surface of the epithelium was covered by a dense layer of mucus. There was also a slight degree of inflammatory infiltration in the mucosa and some edema of the submucosa. (Figs. 4 and 5.)

On June 18, 1958, the patient was operated upon again with the hope of closing the ileostomy. The terminal ileum was markedly thickened with the

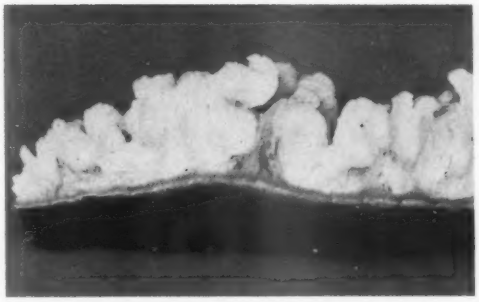
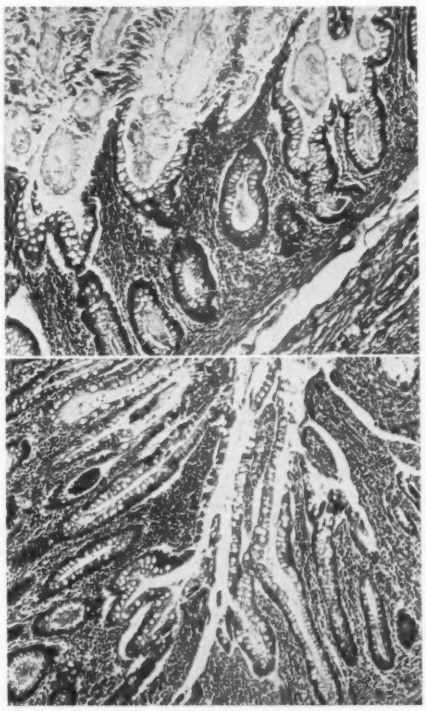


FIG. 3. Slight magnification of resected portion of terminal ileum emphasizes paper-white opacity and nodularity of mucus adherent to mucosal surface. Mucus resembles tumor tissue.



5A

5B

FIG. 5. A, poorly draining tenacious mucus tends to overdistend lumens of mucosal crypts. In upper left corner of field, exfoliated cells have been extruded into mucus, appearing in columns and simulating tissue. B, distention of goblet cells has produced lacy mucosal pattern suggesting hypersecretion, but this effect is probably result of retarded drainage of secretion.

lumen partially patent. Because of these findings, ileo-ascending colon anastomosis was performed with resection of the double-barrel ileostomy, terminal ileum and cecum. (Fig. 6.)

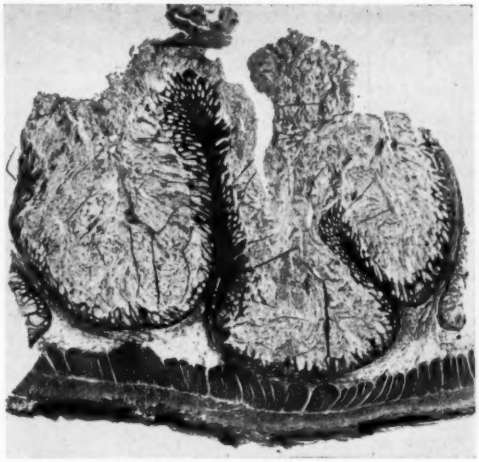


FIG. 4. Longitudinal, stained microscopic section, in low magnification, suggests mechanism by which distinctive globularity and convolutional configurations of masses of mucus are produced. Spaces among valvulae conniventes serve as reservoirs in which mucus becomes inspissated, eventually to be extruded as "casts" of these spaces.

FIG. 6. Resected portion of terminal ileum is filled with gelatinous and tenacious mucus in which there is a coarsely globular structural pattern. Cecum appears grossly normal.

The postoperative course was uneventful and the patient was discharged improved eighteen days later on pancreatin and a diet high in roughage. Since his discharge from the hospital, he has been examined at regular intervals in the surgical clinic, and has been well and free of symptoms.

COMMENTS

Review of this case suggests that exocrine pancreatic insufficiency was causative in producing a mechanical intestinal obstruction

similar to the type of meconium ileus which occurs in the newborn. The rarity of the complication in this age group is stressed. The importance of continued administration of the proper diet and pancreatin is emphasized.

The occurrence of intestinal obstruction as a complication of mucoviscidosis must be recognized. Vomiting and abdominal complaints in a child with known mucoviscidosis should not be treated lightly and attributed as a common symptom of the disease, but rather be investigated as possibly due to inspissation of small bowel contents and to an excessive amount of intestinal mucus. In the presence of these findings, a Mikulicz resection of the distended segment of distal ileum and double ileostomy, as suggested by Gross, should be performed.

By this route, freshly prepared pancreatin can be used to irrigate the small bowel while it is also given by gastric tube after aspiration. By these means the abnormal bowel contents may be softened and liquefied, thus relieving the obstruction.

SUMMARY

A case of mechanical intestinal obstruction in an eleven year old boy with mucoviscidosis is reported.

Gross pathologic and microscopic findings substantiated abnormally increased mucus production of the intestinal glands. Increased surface tension between the inspissated intestinal contents and the ileal mucosa was partially overcome with instillations of a 3 per cent solution of hydrogen peroxide.

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Bleeding from the Liver—An Important Cause of Hemoperitoneum in the Newborn

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NEONATAL hepatic rupture followed by exsanguinating intraperitoneal hemorrhage is a rare phenomenon. However, such hemorrhage may be stopped and life saved by simple surgical procedures should the diagnosis be made. The following case illustrates this.

CASE REPORT

A Negro boy, weighing 6⅝ pounds, was born on December 20, 1957. He was the ninth child of a thirty-two year old woman; birth was uncomplicated. He appeared to be well until he was three days old when he began to breath laboriously and to cry peculiarly. He soon became jaundiced and pale. His abdomen was distended, ecchymoses developed on his left arm, and petechiae appeared on his face. At that time, his temperature was 35.5°C. rectally, pulse rate was 140 per minute, hemoglobin concentration was 6 gm. per cent, and white blood cell count was 32,000 per cu. mm. During the next eight hours his respiratory and pulse rates increased. Thereupon, 60 ml. of whole blood was given intravenously, and aqueous penicillin (300,000 units every three hours), streptomycin (50 mg./kg./day), and chloramphenicol (100 mg./kg./day) were administered. After the transfusion his breathing became less labored and slower, and the pallor decreased but the abdominal distention increased. Percussion elicited dull sounds over the entire abdomen. This, together with the appearance of the plain roentgenogram of the abdomen, suggested that fluid existed within the peritoneal cavity. An abdominal paracentesis was performed and blood, which did not clot, was withdrawn. The child's hemoglobin concentration was 8.1 gm. per cent four hours after the transfusion of blood, but within six additional hours it fell to 6.2 gm. per cent. An additional 30 ml. of blood were transfused, and the child was operated upon. A laceration within the anterosuperior aspect of the right lobe of the liver, 6 cm. long and 3 cm. deep, was found. The laceration was steadily bleeding from several points. It was closed with transcapsular sutures of No. 1-0 chromicized catgut. Approximately 200 ml. of blood were removed from the peritoneal cavity. The child received 120 ml. of blood during the operation. He recovered quickly. At eight months of age the child weighed 17 pounds and was well.

COMMENTS

The liver is the most frequent source of neonatal hemoperitoneum [8]. It is the source of the bleeding in approximately one-third of all cases of hemoperitoneum in the newborn [6,7]. One to 3 per cent of all neonatal deaths and stillbirths are associated with massive bleeding from the liver [6,8,9]. Only seven survivals from proved hemorrhage from the liver have been reported in the English literature. (Table 1.)

The etiology of hepatic hemorrhage and rupture is uncertain. Anoxia, trauma during or after birth, and defects in coagulation are thought to be important factors.

During the second, third and fourth postnatal days, blood clotting is often prolonged even in normal infants. The prothrombin content of blood of infants born by complicated labor is reduced at birth, and it falls still further by the second to fourth day of life [6]. Symptoms of massive hemorrhage from the liver are almost always discovered between the second and fifth days of life. This temporal relationship indicates that clotting defects may be etiologically significant.

Rapid intraperitoneal hemorrhage in an infant is associated with pallor, restlessness, hypothermia, dyspnea and abdominal distention. Frequently, only manifestations of shock exist. Therefore, the diagnosis may be quite difficult to make. Abdominal paracentesis establishes the diagnosis.

TABLE 1

DATA ON PROVED CASES OF HEMOPERITONEUM FROM RUPTURE OF LIVER IN NEWBORNS, WITH SURVIVAL

Reference	Birth Weight and Sex	Beginning of Symptoms	Nature of Delivery	Abdominal Paracentesis	Physical Findings				
					Abnormal Breathing	Hemoglobin	Abdominal Distention	Petechiae or Ecchymoses	Signs of Intra-abdominal Fluid
Arden, 1944..	9 lb., 16 oz.; M	1½ days	Vertex, forceps on head	No	+	52 %	+	?	+
Arden, 1948..	12 lb., 2 oz.; F	40 hr.	Vertex	No	+	?	+	+	+
Rubovits and Strauss.....	?	3rd day	Breech	No	?	?	?	?	+
Grant and Worsley....	9 lb., 4 oz.; M	5th day	Normal	No	+	3.5 gm. %	+	+	+
Greaves.....	5 lb., 10 oz.; F	2nd day	Normal	No	+	?	+	?	0
Brown.....	11 lb., 4 oz.; F	4th day	Difficulty with shoulders	No	?	50 %	+	+	+
Barnes Hospital...	6 lb., 10 oz.; M	3rd day	Normal	Yes	+	6 gm. %	+	+	+

Arden, a pediatrician, believes that operative interference is not indicated in infants suspected of having intraperitoneal hemorrhage from the liver because: (1) It is frequently difficult to find the point of bleeding and to secure hemostasis within the liver of newborns by suture. (2) Bleeding frequently ceases spontaneously during or after the transfusion of blood or the simple passage of time. (3) The increased intra-abdominal pressure associated with the hemoperitoneum tends to stop the bleeding.

These are rather specious arguments for a number of obvious reasons: The liver is the source of bleeding in only one-third of all cases of intra-abdominal hemorrhage in newborns. Laparotomy is necessary to establish the source of bleeding, to surely stop the bleeding from the liver, or to correct another cause of the hemorrhage.

A search of the English literature has failed to disclose any deaths from intraperitoneal hemorrhage from the liver in newborn infants upon whom an operation has been performed. Therefore, an estimate of operative mortality for this condition cannot be made. It is certain that operative intervention does not insure survival, but we are also certain that doing nothing except giving transfusions to the infant does not insure survival either. The autopsy room has borne witness to this many times.

When the diagnosis of intra-abdominal hemorrhage in the newborn has been made, the patient should be given vitamin K parenterally and immediate blood transfusions should be given. Subsequently, should there be signs of continued bleeding, laparotomy should be performed.

CONCLUSIONS

Intraperitoneal hemorrhage from the liver in newborn infants is rarely recognized before death. A simple laceration of the hepatic parenchyma or rupture of a subcapsular hematoma is the source of bleeding. Trauma, anoxia and hemorrhagic diatheses of the newborn have been considered etiologic factors.

The diagnosis of hemorrhage from the liver is suggested by pallor, dyspnea, tachycardia and abdominal distention. Symptoms usually occur from the second to the fifth day of life. Abdominal paracentesis is a simple way of making the diagnosis.

Treatment consists of parenteral administration of vitamin K, blood transfusions and laparotomy.

The seventh case of intraperitoneal hemorrhage from the liver in the newborn reported in the English literature is presented.

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Appendicitis Due to Gallstones

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THE incidence of appendicitis has been reported as being secondary to a large variety of foreign bodies lodged in the appendix. Toothpicks, nails, mercury from broken thermometers and other foreign objects have been found in specimens of this organ. These may cause symptoms either by direct perforation or obstruction. The following is a case report of appendicitis, secondary to obstruction by gallstones.

CASE REPORT

This twenty-six year old man was admitted on November 11, 1958, with a history of vomiting and abdominal pain. After having drunk heavily for the past two evenings, he had been awakened at 2 A.M. on the day of admission with severe non-radiating periumbilical pain. This was not relieved by fluids or alkali and gradually increased in severity, shifting to the right lower quadrant. He vomited several times.

He admitted drinking 2 to 3 quarts of beer several evenings each week for the past eight years. He had had a similar attack of abdominal pain several years prior to admission, which had not required medical attention. Six months previous to admission, he had had a minor episode of hematemesis, and four months before, transient melena. Other than this the past history was non-contributory. Particularly, the patient had not had pain in the right upper quadrant, jaundice, or intolerance to fatty foods.

Physical examination revealed a well developed white man, weighing about 140 pounds, in acute distress from abdominal pain. Temperature was 98.8°F.; pulse, 80 per minute; and blood pressure, 120/80 mm. Hg. Palpation of the abdomen revealed marked tenderness with muscle guarding and rebound tenderness in the right lower quadrant. No bowel sounds were present. Rectal examination showed tenderness in the right side of the pelvis. Laboratory studies on admission showed only the following abnormalities: urinalysis demonstrated 2 plus acetone; white blood count was elevated to 22,800 cells per cu. mm. [3].

The patient was taken to the operating room on the day of admission, and appendectomy was performed. Postoperatively, he was unable to void, and was catheterized once. Three days later, postural headaches developed, which subsided without treatment. The patient left the hospital against medical advice, on November 17, before further diagnostic studies could be performed.

The pathologic report was as follows: the specimen consisted of an appendix measuring 8.5 cm. in length, and varying in diameter from 0.4 to 0.9 cm. The serosal surface was heavily injected and greyish red. On section, the proximal first centimeter appeared normal, but the next segment was dilated and necrotic. Four small concretions were impacted in the lumen at this point. A fifth similar stone was found in the distal portion of the appendix. These stones varied from 0.2 to 0.4 cm. in diameter. They had an external black layer, and a soft brown center. The largest of these was clearly facetted, and they resembled gallstones. The diagnosis was acute appendicitis, with a foreign body in the appendix, probably a gallstone.

These stones were analyzed by the microchemical method of Holt and Tornoky [3], and found to contain bile pigment, cholesterol, fat, protein, calcium and carbonate. They were thus shown to have a composition similar to gallstones. The presence of cholesterol rules out the possibility of enteric origin.

COMMENT

Review of the literature reveals eight cases of appendiceal gallstones together with an additional three quoted by Szuman, making a total of eleven previously reported cases [1,2,4–9]. This includes one case of a pure cholesterol calculus, not definitely identified as such [5]. However, it is extremely unlikely that stones containing cholesterol are formed in any site other than the gallbladder.

In ten of the eleven cases, the signs and symptoms were classic for acute appendicitis.

In three only, disease of the biliary tract was present. One patient had acholuric jaundice, secondary to congenital spherocytosis [6]. In another, a Graham-Cole series demonstrated non-filling of the gallbladder [2]. In the third, incidental appendectomy during cholecystectomy revealed an appendiceal stone [9].

SUMMARY

A case is presented of acute appendicitis associated with gallstones in the appendix. Review of the world's medical literature revealed eleven similar cases.

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The Enigma of Endometriosis

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SAMPSON [1] first accurately described endometriosis as ectopic tissue possessing the histologic structure and function of uterine mucosa. He further described the abnormal conditions resulting from its invasiveness and its relation to menstruation. Endometriosis may involve the uterus (adenomyosis uteri), ovaries, uterine ligaments, rectovaginal septum, fallopian tubes, rectum, sigmoid, bladder, appendix, cervix, vagina, vulva, hernial sacs and laparotomy scars. It is the purpose of this paper to present a case of postoperative endometriosis and discuss briefly the history, pathogenesis and symptomatology of this entity.

In 1903, Meyer [2] published the first reported case of endometriosis in a laparotomy scar, caused, in his opinion, by adenomatous changes in the uterine serosa in contact with the scar. Since that time many theories have been presented as to the pathogenesis of scar endometriosis. In 1950, Schwartz and Farinacci [3] listed the more popular hypotheses as follows:

1. Mechanical transplantation theory of von Franque which suggests that scar endometriosis might be due to mucosa implanted into the wound.

2. Coelomic metaplasia theory of Iwanoff which suggests that the development of aberrant endometrium from coelomic epithelium is causative.

3. Implantation theory of Sampson which states that endometrial tissue is disseminated at surgery.

4. Metastatic theory of Holban which favors dissemination of endometrial tissue through the pelvic lymphatics.

5. Direct outgrowth of uterine mucosa from a scar to adjacent adherent tissue.

6. Sampson's theory of direct outgrowth of mucosa from the tubal stump.

Despite these theories, the pathogenesis of scar endometriosis remains nebulous.

CASE REPORT

On August 27, 1958, a twenty-two year old white woman, gravida 0, para 0, was admitted to the Robert Packer Hospital-Guthrie Clinic with a "bleeding spot" in the right groin of one year's duration. The patient stated that she had noted the appearance of a "brownish blister" about one year prior to admission. It had increased slightly in size. In the five to six months prior to admission, the "blister" became larger about one week prior to menstruation, and at menstruation it oozed blood for the full length of the period. Pain had not been present. Her menstrual history was normal except for mild dysmenorrhea present since the menarche at the age of twelve years. Review of the past history revealed that the patient had been operated on for acute perforated appendicitis at the age of six years.

On examination, a brownish, flat area about 8 mm. in diameter was identified in the middle of a well healed transverse appendectomy scar. (Fig. 1.) (It is interesting to note that at the previous surgery the drain had been placed in the lateral margin of the wound.) Pelvic examination revealed a normal-sized, mobile uterus; cervix and adenexae were normal. A presumptive diagnosis of ectopic endometriosis was made.

At surgery, the scar from the previous appendectomy was excised. Typical chocolate implants with small cysts were identified in the subcutaneous tissues. Exploration was carried down to the internal oblique muscle. No further evidence of cysts was found below the level of the subcutaneous tissues. Microscopically, numerous islands of typical-appearing endometrium were identified. (Fig. 2.) The postoperative course was uneventful, and the patient was discharged on the fourth hospital day.

COMMENTS

The symptoms of scar endometriosis are variable. The scar may become tender, espe-

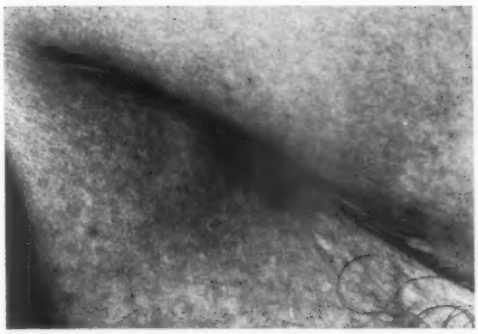

FIG. 1. Illustration of the abdomen of the patient with a complete view of the scar showing in the center area extensive subcutaneous hemorrhages.

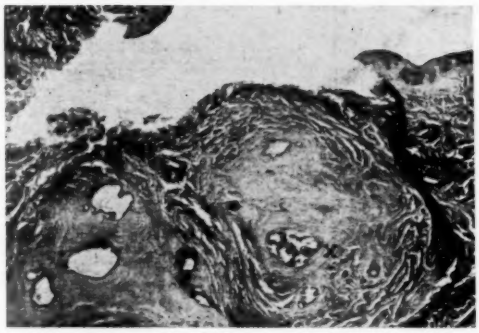

FIG. 2. Photomicrograph of a vertical section of the scar. The subepithelial region shows evidence of increased fibrous elements and moderate inflammatory reaction of the chronic type. Deep in the dermis, there are extensive areas of myxomatous type stroma having numerous endometrial glands.

cially at menstruation, and a bloody discharge may be associated with it. The pain usually subsides when drainage ceases. A firm nodule is commonly identified in or below the scar. The diagnosis of this entity is not always an easy one. As pointed out by Wyrens and Randall [4], scar endometriosis may be misdiagnosed as keloids, desmoid tumors, fibromas, unabsorbed sutures, foreign bodies, neuromas, "painful scars," granulation tissue, or adhesions.

Which of the popular theories can best account for the presence of endometrial tissue in the scar of this twenty-two year old woman? It would appear simplest to explain this phenomenon by the mechanical transplantation theory. How can we account for the lack of symptomatology during the nine-year period from the menarche to the onset of symptoms? Perhaps it may be that the cysts were too small, and on gradual increase in size, produced symptoms. These answers appear plausible and practical, but not definitive. Until conclusive proof is presented, the enigma of scar endometriosis remains unsolved.

SUMMARY

A case of scar endometriosis is presented. The history, pathogenesis, symptomatology and differential diagnosis have been discussed briefly.

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Gangrene Following a Compound Colles Fracture

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THIS case report is of interest because of the unusual complication of gangrene following a compound Colles fracture. The Colles fracture is the most frequent injury to the wrist in an adult, and it is due to a fall on the hyperextended wrist. A compound fracture is not very common at the wrist joint unless there is an extreme injury, despite the proximity of the radius and ulna to the surface. The present case has several unusual facets: Overwhelming infection developed in spite of excellent precautions and early surgery, and gangrene without gas formation occurred with resultant shock.

CASE REPORT

This forty-two year old white male painter was admitted to the University of California Medical Center at Los Angeles with an open fracture of his left wrist. He had fallen the distance of two floors from a roof, and his wrist was lacerated with protrusion of the radius and ulna. The distal ulna and radius were protruding through a 6 cm. volar laceration, and there was some loss of sensation in the fourth and fifth fingers. The circulation to the

FIG. 1. Compound fracture of wrist revealing marked displacement of fragments.

FIG. 2. Open reduction of fracture and immobilization in plaster.

extremity was adequate. (Fig. 1.) He was taken to surgery, and the wound was thoroughly irrigated with normal saline solution, after which the wound edges were débrided. It was noted that the ulnar artery was ruptured. The fracture was reduced and the wound was closed loosely. This was followed by the application of a long arm cast. (Fig. 2.) The time interval from injury to surgical débridement was three hours. The patient received chloromycetin, streptomycin, 20,000 units of tetanus antitoxin and an ampule of gas gangrene antitoxin. Abour twenty-four hours after operation, a spiking temperature began to develop, and the patient had a shaking chill. Within the next twenty-four hours he became very toxic and examination of the extremity revealed marked swelling of the forearm and hand without crepitation. A smear of the wound revealed the presence of many large gram-positive bacilli. The patient was given massive doses of penicillin intravenously, but because of his progressive downhill course he was taken to surgery. Incision of the forearm produced copious amounts of greenish, malodorous pus which extended beneath the deep fascia. There was pus at the fracture site, and amputation was performed below the elbow as a life-saving procedure. Following surgery the patient made an amazing recovery. A guillotine type of amputation (Fig. 3) was performed, and traction was applied to the skin margins. The culture of pus from the wound revealed Clostridium perfringens, klebsiella-aerobacter group, and Escherichia freundii. Blood cultures were negative.

The pathologic report disclosed extensive edema of the skin of the hand and forearm. There was no crepitation present or any evidence of gas formation.

FIG. 3. Specimen of arm removed surgically as life-saving procedure.

SUMMARY

A case is presented of overwhelming infection as an unusual complication of a compound fracture.

Wide Block Excision of Desmoid Tumors of the Chest Wall and Repair with Stainless Steel Wire Mesh

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CELLULAR fibromas, or desmoid tumors, of the chest wall are unusual or at least infrequently reported entities. Gatchell, Clagett and McDonald [1] made the first report of such a case. They reviewed the literature of desmoids in general and discussed the etiology and incidence so completely that it need not be repeated here. It was emphasized that radiation therapy was considered to be of little value and that surgical block excision was the one effective means of eradication.

Since this report, McKell, Kettle and Boley [2] have reported a case in which treatment consisted of excision of the chest wall contiguous with the tumor. Wiper and Miller [3] (1946) reported a case of an infraclavicular desmoid treated by excision of the pectoralis muscle and fibrous encapsulation of the tumor.

Carty [4] (1954) reported a desmoid of the left infracapsular region which was treated by excision of the tumor and a portion of the scapula. A small recurrence was removed from the lateral edge of the scapula two years later.

Musgrose and McDonald [5] wrote a comprehensive review of the localization and pathologic features of this type of tumor.

It is generally agreed that desmoid tumors vary greatly in their metastasizing potentiality and that one cannot foretell the course of the disease from the microscopic findings, either by frozen section or regularly prepared sections.

We wish to report another case which demonstrates a satisfactory method of dealing with this entity.

CASE REPORT

J. B. C., a thirty-six year old white man, was admitted to Mount Zion Hospital on May 2, 1954. His chief complaint was relative to a tumor of the back which had been present for many years, but which he thought had grown during the previous three months. His history disclosed no abnormalities except the presenting complaint. Physical examination revealed a mass, approximately 3 cm. in diameter, deep in the rhomboideus region of the back, just at the angle of the right scapula.

The patient was operated upon on May 3. A curvilinear incision was made over the seventh rib posteriorly and dissection was extended through the muscles to the region of the eighth rib. The tumor presenting here was carefully dissected free from the surrounding tissues and found to be closely adherent to the rib. It was possible to separate the tumor from the surface of the rib, leaving a rough bleeding bed. A diagnosis of cellular fibroma was made by frozen section. It was decided to proceed with radical excision of the involved area. Accordingly, the rib above was exposed and was also found to be involved in a separate mass. This mass, when examined, was of the same histologic type as the previously described tumor. Accordingly, dissection was extended higher to the region of the sixth rib. The periosteum was stripped from the sixth rib. The seventh and eighth ribs were then transected at distances approximately 4 to 5 cm. on either side of the tumor in order to remove the entire chest wall *en bloc*, including the pleura. The block removed included the seventh and eighth ribs and the sixth, seventh and eighth intercostal bundles, as well as the overlying extracostal muscles and skin.

In order to close the defect, transplantation of the anterior ends of the sixth and ninth ribs to the anterior stumps of the seventh and eighth ribs was employed. The sixth and ninth ribs were transected posteriorly and anteriorly, and the anterior

ends were maintained in their new position by stainless steel wire sutures placed through drill holes. Care was taken to preserve the intercostal blood supply posteriorly. Three interrupted pericostal sutures of No. 2 chromic catgut were placed to decrease movement of the ribs. A sheet of stainless steel wire mesh was then placed to overlap the entire defect from the fifth to ninth ribs. The wire mesh was sutured to the thoracic fascia with interrupted sutures of Surgaloy.® The extracostal muscular layer was next closed over the wire mesh by means of interrupted sutures of No. 1 chromic catgut. The superficial thoracic fascia was sutured over the muscle layer with catgut and the skin edges approximated with No. 2-0 silk sutures. An intercostal catheter was used for drainage of the pleural space. A tight adhesive strapping was applied to the chest wound.

The pathologic report was as follows: Grossly, the fixed specimen consisted of a piece of tissue measuring 6 by 4 by 2.5 cm. Most of its parenchyma was made up of very soft tissue which was milky white and gray in color. One margin of it contained what appeared to be a previously opened cystic structure, measuring 4 by 4 cm. in diameter, and 0.2 cm. in thickness. The luminal surface was smooth and shiny with a few pitted areas.

The second specimen consisted of a linear wedge of skin with underlying skeletal muscle and two attached segments of rib, intercostal muscle and pleura. The skin measured 14 cm. in length and 3 cm. in maximum diameter. Along its longitudinal axis was a 6.5 cm. linear, recently surgically closed incision. Attached to the underlying surface of the skin was a mass of skeletal muscle, periosteum and ribs measuring 13 by 5 by 4 cm. There was gross hemorrhage beneath the surgical incision and superficial to the skeletal muscle. One rib measured 9 cm. in length; the other 11.5 cm. in length. The deep surface of the ribs had a smooth shiny gray lining. Within the fibrofatty tissue, between the skeletal muscle and the outer surface of the rib, there was an area of firm gray tissue (3 by 2 by 2 cm.) which fused imperceptibly with the surrounding fibrofatty tissue and extended to the peri-

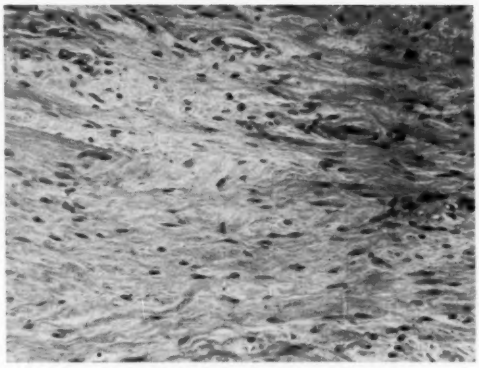

FIG. 1. Photomicrograph of tumor tissue.

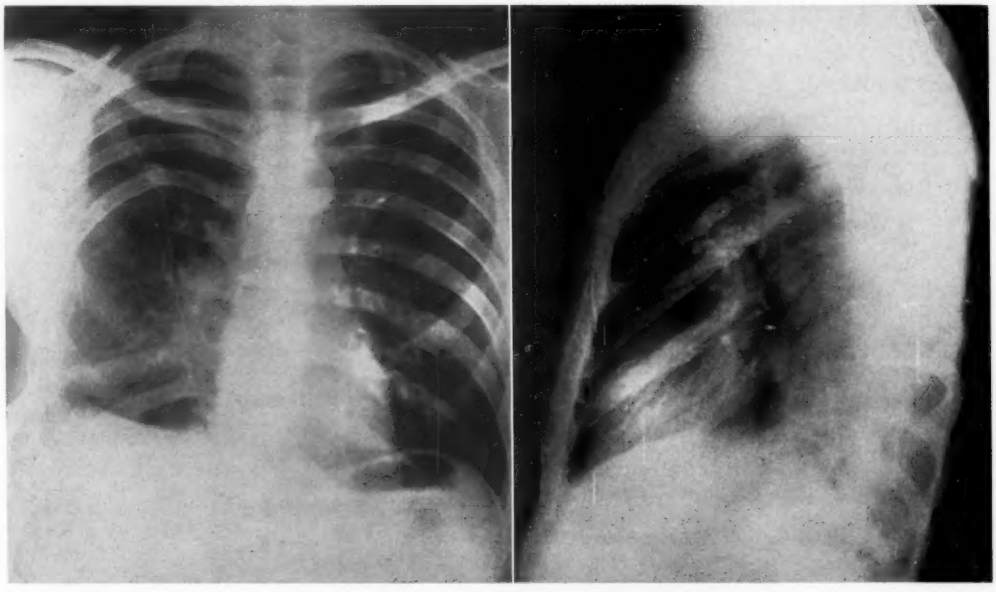

FIG. 2. Postoperative x-ray films of chest (1954).

osteum of the bone. Also present were six segments of rib, ranging in length from 1.2 to 1.8 cm.

Microscopically, a rather discrete but nonencapsulated lesion was seen, showing the following changes: it was composed of scattered oval to spindle-shaped cells, separated by variable amounts of collagenous ground substance. (Fig. 1.) In some areas, the ground substance was loose. In other areas, it was dense and hyalinized with a greater degree of cellularity. The ground substance took on a green color with Masson's trichrome stain. The moderate-sized round to oval nuclei in the fibroblastic type of cells were relatively uniform in size and shape, and significant pleomorphism or mitotic activity was not seen. A few skeletal muscle fibers were incorporated within the lesion near its margin. A reticulum stain revealed no argyrophilic fibers investing the fibroblastic cells. No violaceus pink mucinous material was seen in the ground substance about the cells in the periodic acid-Schiff stain. Vascular fibrofatty tissue surrounded the lesion. The rib showed no significant histologic abnormality. There was no evidence of malignancy. The diagnosis was a desmoid type of tumor contained in tissue from the back.

The patient made a completely uneventful recovery and was discharged on the thirteenth postoperative day.

At the time of writing, five years postoperatively, he is apparently free of recurrence. Follow-up roentgenograms of the chest demonstrate a very satisfactory repair. (Fig. 2.)

COMMENTS

The basic objective in the management of cellular fibrous tumors of this type is to obtain wide block excision of the tumor and surrounding tissue. We have demonstrated a method of reconstruction of the chest wall after complete block excision of such a tumor.

It is sometimes difficult to differentiate desmoids, cellular fibromas and low grade fibrosarcomas. However, in all of these, one must recognize the need for wide block excision to preclude later recurrence. The apparent benignancy of the cellular pattern should not delude the surgeon and cause him to perform less than radical excision of the tumor mass and surrounding tissue.

SUMMARY

A case is reported of cellular fibroma of the chest wall which was treated by wide block surgical excision and reconstruction of the chest wall by rib transplantation and stainless steel wire mesh implant. The patient is in no way disabled and there is no recurrence after five years.

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Melanoma Developing from a Café-au-Lait Spot

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THE purpose of this paper is to try to show, by a personal case and by excerpts from and quotations of authors who have made many penetrating studies of this subject, that any melanin-forming skin lesion, including moles which do not contain either pigment or nevus cells [*1*], is a potential melanoma.

For many years I have found the complicated and conflicting terminology used in reference to many pigmented skin lesions confusing but particularly in reference to the so-called nevi. Not only is the literature confusing, but also the clinical differentiation is difficult, if not impossible. Lesions which appeared clinically to be moles would be reported as lentigines, dermal nevi as junctional nevi, and junctional nevi as nevus pigmentosus et pilosus, simple warts as verrucous nevus pigmentosus or papillary nevus.

As my experience increased, it became more and more evident that all of the melanin-containing lesions of the skin are "blood brothers" and even the lowliest freckle has malignant potentialities.

The following case, in which a malignant melanoma developed in an apparently harmless café-au-lait spot, helped to formulate my ideas more clearly, and to learn that views similar to mine are to be found scattered throughout the literature even though this fact does not seem to be generally known.

CASE REPORT

Mrs. L. G., a thirty-three year old woman, was first seen on August 26, 1955, complaining of a café-au-lait spot on the bridge of the nose which had begun to change in appearance and become elevated about four months previously. About two months previously a black spot appeared in one corner of it.

Family history revealed no café-au-lait spots or von Recklinghausen's neurofibromatosis; however, her father had had two "skin cancers" and her grandfather and two uncles had had tuberculosis.

Past history demonstrated tonsillectomy and adenoidectomy at the age of eight years, appendectomy at the age of twelve years, and fractured tibia and fibula at twenty-four years of age. Otherwise, she had had good general health.

From birth she had had many freckles and at least two café-au-lait spots, one on the right side of the bridge of the nose and one on the inner surface of the left thigh. As stated, the spot on the nose began to change its characteristics four months previously and an elevated, black spot developed two months before the patient came to my office. There had been no ulceration or crusting.

Physical examination revealed the following: blood pressure, 140/90 mm. Hg; pulse, 100 per minute; respirations, 20 per minute. The patient was a slender, auburn-haired woman who had numerous freckles over the exposed surfaces of the body, the fair skinned, reddish-haired, freckled type so often referred to by Dr. Pack. Situated on the bridge of the nose, predominantly on the right side, was a roughly triangular light brown or coffee-colored lesion resembling a café-au-lait spot in von Recklinghausen's disease. In the left-hand corner of this was a black, slightly elevated area approximately 0.5 cm. in diameter which had all the characteristic appearances of a melanoma. (Fig. 1.) No areola or streaking into the surrounding tissues was present and the margins were sharp. The remaining skin surfaces were clear except for freckles and a long, narrow, typical café-au-lait spot on the inner surface of the left thigh measuring approximately 3 by 1.75 cm. No glands were palpable in the neck, axillas, or groin. The remainder of the examination, including the toes, anal area and genitalia, was non-contributory. There were no neurofibromas.

A diagnosis of malignant melanocarcinoma was made and, without biopsy, the lesion on the nose was excised down to the periosteum of the nasal bones with a generous margin of normal skin, and without manipulation of the tumor. A split-

FIG. 1. Preoperative appearance of the café-au-lait spot and melanoma.

thickness graft was applied, and the patient was discharged the following day. The graft was successful in its entirety.

The pathologic report was as follows: Malignant melanoma of skin of the nose. (Fig. 2.)

In order to ascertain whether the original lesion and one on the left thigh were actually café-au-lait spots, the patient was eventually persuaded to have the lesion on the thigh excised. This was performed on April 19, 1956. The pathologic report was as follows: epidermal basal cell melanoblastic activity consistent with clinical café-au-lait spot of skin of left leg. (Fig. 3.)

The patient was last seen on February 12, 1960, without evidence of recurrence.

The term melanoma is used by various authors in two different senses. According to Lever [2], "melanomas, in the broad sense, are tumors either benign or malignant, composed of nevus cells." The recent trend, however, is to follow the restricted sense, reserving the term melanoma for definitely malignant lesions. Ormsby and Montgomery [3] state that "melanoma is the official term in the Standard Nomenclature of Diseases for Malignant Melanoma, but many articles have appeared in the literature in which the name 'melanoma' is attached to benign lesions."

The terms melanocarcinoma and melanoepithelioma are not generally used because, according to Ormsby and Montgomery [3], they involve the origin of the nevus cells, concerning which there is still a great deal of disagreement.

The following quotations from the literature show that any pigmented (melanotic) lesion, including even normal skin freckles, must be considered a potential melanoma.

Boyd [4] stated that, "between the cells of a nevus is an abundance of fine non-medullated nerve fibrils. In the dermis the medullated nerve fibers terminate in Meissner's corpuscles, from which non-medullated nerve fibers pass into the epidermis and end in the tactile corpuscles of Merkel-Ranvier. Both of these corpuscles are composed of specialized cells. Associated with these cells there are pigmented chromatophores, known as the cells of Langerhans. According to Masson, a melanoma is merely a proliferation of the entire end organ, which in the dermis is represented by Meissner's corpuscles plus chromatophores and in the epidermis by the corpuscles of Merkel-Ranvier plus chromatophores.

This would bring a nevus into line with the pigmented spots found in the skin in neurofibromatosis, and would serve to harmonize both the epithelial and the chromatophore theories of origin."

Ormsby and Montgomery [3] state that, "malignant melanomas appear to arise from melanoblasts and appear to be of the same origin as the melanocyte, or pigmented-producing cell in the epidermis, and the nevus cell, both of which now appear to arise from the neural crest."

Lever [2] writes that, "all steps in the transition from lentigo to junction nevus may be encountered and occasionally one may see the histologic picture of lentigo at the margin of the junction nevus. Lentigo may develop into a malignant melanoma . . . ," and "lentigo must be differentiated from ephelis (freckle)."

Eller and Eller [1] state that, "if a lentigo becomes suddenly large and develops into a malignant melanotic tumor, it is known as lentigo maligna . . . Any combination of nevi, not only cellular, but of any type, may be noted in the same lesions."

Ormsby and Montgomery [3] indicate that, "many melanomas, however, develop from apparently normal skin."

After encountering the previous case, a search through the literature for other cases of the so-called café-au-lait birthmark becoming malignant did not uncover a single instance. A personal communication from Dr. A. C. Allen on June 3, 1957, in New York City informed me

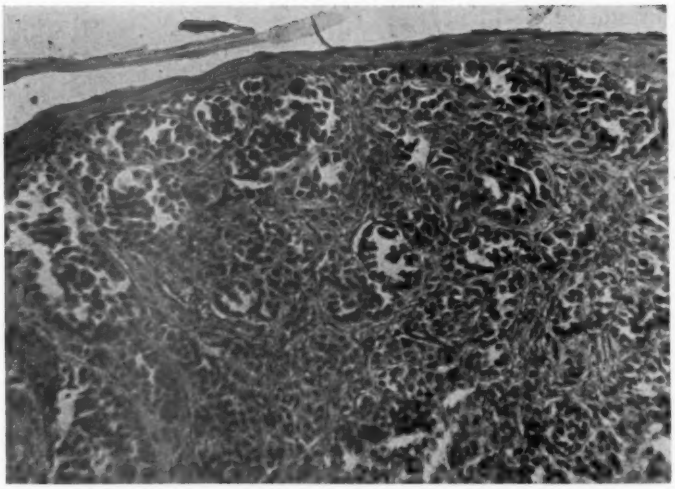

FIG. 2. Microscopic picture of the melanocarcinoma which developed in the café-au-lait spot on the nose.

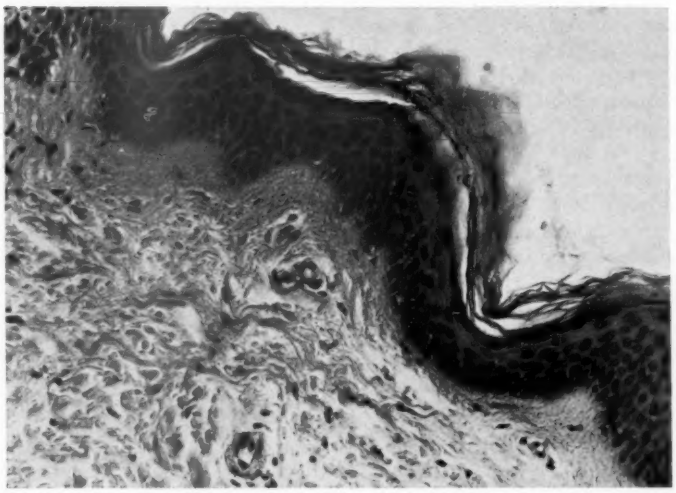

FIG. 3. Microscopic picture of the café-au-lait spot on the thigh, showing merely increased pigment and a few clear cells.

that, to his knowledge, the only similar case was in the process of being published by Dr. N. G. Perkinson, Atlanta, Georgia. This case report has since been published [5] and differs from my case report chiefly in that Dr. Perkinson's patient manifested the neurofibromatosis characteristic of von Recklinghausen's disease, whereas my patient, likewise a woman, did not.

It is doubtful whether the patient reported on herein can rightfully be considered to have von Recklinghausen's disease. Crowe and Schull [6] state that, "there are no symptoms referable to the café-au-lait spot *per se*, and in contrast to the lentigo, it is not known to undergo malignant degeneration." They disagree with Siemens in that they do not believe there is any difference between the café-au-lait spots in von Recklinghausen's disease and those in normal persons. Lever [2], Stout,

McNair and many others believe that the only change from the normal skin in a café-au-lait spot is the increased formation of melanin. However, Perkinson [5] found junctional activity in another café-au-lait spot removed at random from his patient. Junctional change was not noted in a non-malignant café-au-lait spot which I removed from my patient.

Perhaps the case presented herein falls into the category of the so-called "forme fruste," which shows only the café-au-lait spot without the neurofibromatosis. Crowe and Schull [6] state that, "the initial descriptions of the physical and pathological findings in this disease, as given by Razer, Smith, and von Recklinghausen (Festschrift für Rudolf Virchow, Hirschwald, Berlin, 1882) did not include the pigmentary changes. The addition of these to the primary complex may be credited to Marie and Bernard (*Soc. Med hôp., Paris*, 13: 200, 1896) and to Chauffard (*Ibid.*, 13: 777, 1896). Again, Crowe and Schull [6] state that, "Café-au-lait spots may vary in size and configuration, may be single or multiple, and may be located on any part of the body. However, in contrast to the ephelides, they are more prevalent in the unexposed areas of the skin."

Regarding the "forme fruste," however, Kiyoshi Hosoi [7] states that, " . . . the use of the term 'incomplete neurofibromatosis' by some dermatologists when only café-au-lait spots or melano-derma are present in familial cases is not justified."

Also, Wise and Eller [8] state that, "the presentation before various dermatologic societies of patients who exhibited only cutaneous pigmentations has occasioned discussions as to the propriety of naming such cases as Recklinghausen's disease."

Penfield and Young [9] have stated that, "frequently, the only stigmas of the inherited taint are the scattered pigmentary spots irregularly distributed over the body, varying in size from that of a pinhead to that of a large plaque and colored a light yellow, café-au-lait or deep brown."

SUMMARY

The case of a thirty-three year old woman who developed a malignant melanoma in what appeared to be a café-au-lait spot is presented. Only one such case has been reported previously in the literature.

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Complete Regression of Vesical Carcinoma Following Urinary Diversion

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REGRESSION of urinary vesical carcinoma after urinary diversion has been reported in the literature. In this respect, vesical cancer differs from that group of neoplasms undergoing truly spontaneous regression [1]. Hellstrom [2] mentions, in his study of seventy-four cases of ureterosigmoidostomy, that many papillomatous tumors may markedly subside after bilateral ureteral implantation. Fifteen cases of vesical cancer have been reported which regressed partially or completely within eight days to three months after urinary diversion. Seven of these (five of which had preoperative biopsies) revealed complete histologic regression. (Table I.) Seven regressed incompletely with residual submucosal tumor cells demonstrated in four and benign papillomas in two. One has regressed grossly by cystoscopic examination. (Table II.) The present report adds one case to the four in the literature which, with preoperative and postoperative histology, revealed complete regression after urinary diversion.

CASE REPORT

A sixty-nine year old retired night watchman entered the hospital July 1957 with a chief complaint of having had to void every half hour, day and night, for the past year. During the previous eight months he had resorted to wearing an external collecting device. He denied gross pyuria, hematuria or lithuria. There had been no back pain, fever or weight loss.

Five years earlier, a papillary lesion of the fundus of the bladder, 2 cm. in diameter, had been resected and the base fulgurated. The histologic diagnosis was transitional cell carcinoma, grade III.

TABLE I

COMPLETE REGRESSION OF VESICAL CARCINOMA ON POSTOPERATIVE GROSS AND HISTOLOGIC EXAMINATION

Author	Preoperative Cystoscopic Findings	Results of Preoperative Biospy
Pearse, 1943 [3]	Infiltrating tumor on posterior wall of bladder	None
Trabucco, 1948 [4]	Papillary carcinoma on right lateral wall and surrounding bladder neck	Papillary carcinoma
Goldberg, 1950 [5]	Patchy, dull, velvety areas with two small sessile papillary growths in right fornix, and another sessile papillary area on anterior wall	Transitional cell carcinoma with marked invasion
Abeshouse and Scherlis, 1951 [6]	Two fungating papillomatous growths on right lateral wall	Papillary carcinoma
Abeshouse and Scherlis, 1951 [6]	Infiltrating tumor of right wall	None
Fort, Harlin and Atkinson, 1951 [7]	Papillomatous growth surrounding neck and protruding into urethra. Larger growths on right inferior lateral margin of vesical neck	Papillary carcinoma, grade II
Mahoney, 1960	Generalized erythema; papillary lesions on left lateral wall	Papillary carcinoma, squamous, grade III

TABLE II

PARTIAL REGRESSION OF VESICAL CARCINOMA ON POSTOPERATIVE GROSS AND HISTOLOGIC EXAMINATION

Author	Preoperative Cystoscopic Findings	Results of Preoperative Biopsy	Pathology Report on Excised Bladder
Pearse, 1943 [3]	Sessile tumor, 3 cm. in diameter, projecting 2 cm. into bladder cavity, posterolateral to left ureteral orifice	None	Gross: no neoplasm; histology: solid plugs of carcinoma in muscle layer
Davis, 1948 [8]	Crater-like 2 cm. ulceration with elevated edge situated behind trigone and to left of midline	Carcinoma	Gross: no neoplasm; histology: cancer cells underlying normal mucosa
Davis, 1948 [8]	Slightly elevated, 2½ cm. lesion with edematous and reddened surface on left lateral wall	Carcinoma	Gross: no neoplasm; histology: cancer cells underlying normal mucosa
Abeshouse and Scherlis, 1951 [6]	Recurrent large papillary tumor with infiltration at base on right lateral wall	Transitional cell carcinoma, grade II	Gross: two small papillomas near right ureteral orifice; histology: no cancer cells
de Gironcoli 1951, [9]	Large cauliflower-like growth filling entire right half of bladder	Papanicolaou smear positive	Normal bladder with slight reddening by cystoscopic examination
de Gironcoli 1951, [9]	Growth involving entire neck of bladder	Papillary carcinoma	Gross: small papillary lesion on neck of bladder; histology: simple papilloma
Crone-munzebrock and Boeminghaus, 1953 [10]	Broad-based solid tumor on posterior wall, palpable bimanually	Solid carcinoma	Gross: no neoplasm; histology: tumor cells
Brosig, 1953 [11]	Large tumor obscuring left ureteral orifice	Solid carcinoma	Gross: no neoplasm; histology: solid infiltrating carcinoma involving upper layers of muscular wall

(Fig. 1.) Subsequently, he had done well and was essentially asymptomatic until one year prior to this admission.

His family history was negative for carcinoma, and system review disclosed no abnormalities. No history of exposure to vesical carcinogens was elicited.

On physical examination, the blood pressure was 120/75 mm. Hg; there was no costovertebral tenderness or renal enlargement. The prostate was benign and estimated to weigh 30 gm.

Laboratory studies revealed that the urine was completely negative for abnormalities except for a rare leukocyte in a spun sediment; the blood urea nitrogen was 15 mg. per cent. The urine culture revealed Micrococcus tetragenus. The leukocyte count of the blood was 8,200 per cu. mm. and the hematocrit was 43 per cent. X-ray films of the chest and skeleton revealed no evidence of metastases. Barium enema and sigmoidoscopy showed no invasion of the large bowel.

The bladder capacity was found to be 40 cc. A cystogram demonstrated bilateral ureteral reflux and an irregularity of the superior and right areas of the bladder. The excretory urogram revealed no abnormality of the upper urinary tract. The mucosa of the bladder at cystoscopy appeared to be intensely erythemic throughout with a diffuse area of minute papillary lesions on the left lateral wall. Biopsy specimens from the right and left lateral walls, and a fragment of tissue floating free within the lumen of the bladder contained malignant cells. The histologic diagnosis was papillary carcinoma, squamous, grade III. (Fig. 2.)

First-stage bilateral ureterosigmoidostomy, using a tunnel and elliptic mucosa-to-mucosa anastomosis, was performed. Seven weeks later, after a stormy postoperative course, the patient underwent abdominoperineal total cystectomy. Pathologic examination of the bladder, despite an intense search involving the microscopic study of multiple sections of the bladder, failed to reveal any malignant cells either in the wall or mucosa of the specimen.

The patient's postoperative course has been smooth except for periods during which he elected

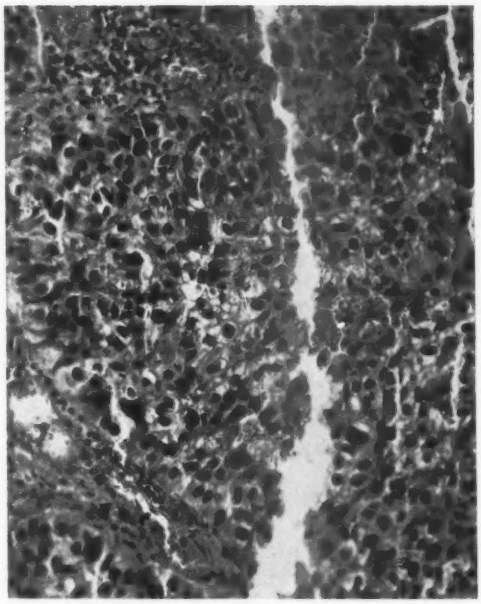

FIG. 1. Section from biopsy of tumor of bladder showing anaplastic character of epithelium.

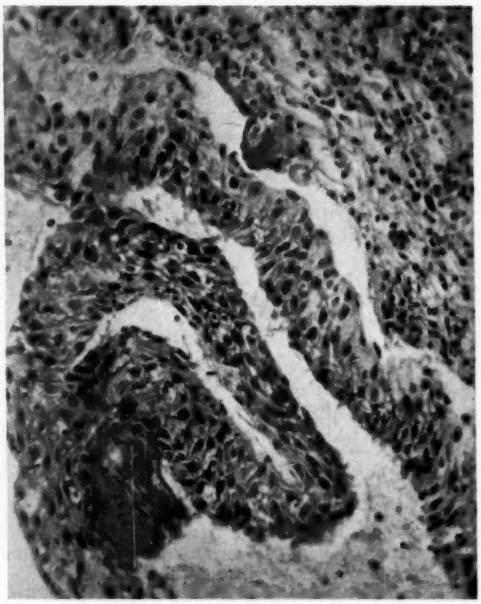

FIG. 2. Section from biopsy of tumor of bladder. Observe disorganized growth pattern and variation in size, shape and staining characteristics of nuclei.

to omit the sodium bicarbonate medication and hyperchloremic acidosis developed. He is asymptomatic and feeling well. His blood urea nitrogen was 17.5 mg. per cent fifteen months following surgery, and there was no evidence of recurrent tumor.

The patient died of confluent bronchopneumonia of the right middle, right lower and left lower lobes, and focal myocarditis, as demonstrated at autopsy, two and a half years after his first admission. Transitional cell carcinoma was found in the liver, retroperitoneum and perirectal area, the latter causing obstruction of the left ureter. This does not alter the basic thesis, but rather indicates that metastatic spread had occurred prior to urinary diversion and the subsequent complete regression of his primary carcinoma.

COMMENTS

A sixteenth case of regression of vesical carcinoma following urinary diversion, and the fifth with pre- and postoperative histology to demonstrate complete regression, is added to the literature. The short interval, varying from eight days to three months after diversion, during which the carcinomas regressed is of interest and supports the view that these neoplasms were dependent for their survival upon a continued supply of urine-borne carcinogens. The occurrence in normal urine of carcinogenic tryptophan metabolites, and their increase in patients with vesical neoplasia, led to Wallace's [*13*] concept that the effect of the carcinogen was dependent upon the duration of exposure and its urinary concentration. This possibility is supported by the two clinical observations [*9,11*] in which tumor partially regressed following unilateral ureterosigmoidostomy with diversion from the bladder of presumably one-half of the total urinary volume. Scott's [*12*] experimental studies revealed similar findings. His intact dogs which were fed beta-naphthylamine all demonstrated neoplasia of the bladder, while those animals whose bladders were deprived of urine from one kidney by unilateral ureterosigmoidostomy failed to develop vesical tumors.

The described clinical instances of tumor regression subsequent to diversion are consistent with the investigations implicating urine-borne carcinogens. At this time, Wallace's [*13*] suggestion that elimination of stasis and the production of a dilute urine may have a preventive influence on vesical neoplasia deserves serious consideration.

SUMMARY

A sixteenth case of complete regression of vesical tumor following urinary diversion is presented. The reviewed cases present clinical evidence to support and encourage studies implicating urine-borne carcinogens in vesical neoplasia.

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Management of Division of Aberrant Subclavian Artery

JAMES R. LLOYD, M.D., *Columbus, Ohio*

From the Department of Pediatric Surgery, The Children's Hospital, Columbus, Ohio.

PATIENT J. M. L., a two and a half month old male infant, was first admitted to The Children's Hospital at the age of six weeks. The baby had been well until about the third week of life. At that time, his mother noted a gradual onset of respiratory difficulties characterized by noisy, wheezing respirations and supra- and substernal retractions. At first this condition was attributed to a common cold but the persistence of symptoms alarmed the mother and she called the family doctor. He examined the baby and started treatment with antibiotics. When the respiratory condition did not improve, he referred the baby to The Children's Hospital for a more thorough evaluation.

On physical examination the infant appeared healthy, but he had a mild respiratory stridor. The pharynx was clear, the nares were patent and there was slight rhinorrhea. Minimal to moderate retractions of the chest were noted by some observers.

A routine blood count and urinalysis were within normal limits. Roentgenographic examination consisted of a plain film and fluoroscopic studies of the chest. The lung fields were clear, but the barium swallow demonstrated an oblique defect of the upper esophagus. This was thought to be due to an aberrant artery. Before surgical consultation could be arranged, parenteral diarrhea developed which was treated with a good response. The respiratory difficulty was not considered serious at this time, and the baby was discharged from the hospital on the seventh hospital day to the care of the family physician.

During the following month at home the respiratory symptoms did not improve and he began to have "choking spells" during feedings. Because of the progressive nature of the symptoms, hospitalization was again advised.

The patient was now ten weeks old and no significant distress was noted on physical examination. He preferred to lie on his abdomen with his head held back in hyperextension. In this position, respirations were less labored and retractions less pronounced. The nares were patent as were the nasal passages. Direct laryngoscopy confirmed the presence of a normal larynx. There was no evidence of central nervous system involvement of the pharyngeal musculature. It is significant that forward flexion of the head on the neck produced nearly complete obstruction of the airway. There were no other important physical findings.

The routine blood count and urinalysis were within normal limits. A repeat barium swallow again showed an oblique defect of the proximal esophagus which passed upward from left to right. Surgical consultation was requested. A diagnosis of aberrant retroesophageal right subclavian artery was made and division of the offending vessel was recommended.

The infant was taken to the operating room on December 2, 1958. Under cyclopropane-oxygen endotracheal anesthesia, with the left chest elevated about 30 degrees, anterolateral thoracotomy was performed through the third

intercostal space. The left lobe of the thymus gland was removed; the lung was folded down and the mediastinal pleura was opened behind the vagus nerve exposing the descending aortic arch and the left subclavian artery. Tapes were passed around the aorta and the left sublcavian artery for purposes of traction. With the aorta elevated from its bed, the right aberrant subclavian artery was readily identified. The vessel arose from the posterior aspect of the aorta just proximal to the origin of the left subclavian artery. It was exposed well back under the esophagus and divided between ligatures. The retroesophageal space was debrided of all perivascular tissue and the distal end of the divided vessel was positioned to the right of the esophagus. The chest was then closed and a No. 20 straight catheter was placed in the pleural cavity through a separate stab wound in the sixth intercostal space on the left side at the anterior axillary line. As in our routine, a postoperative chest film was obtained to make certain that the lung was adequately expanded. The chest tube was removed after eighteen hours and the remainder of the recovery was uneventful. The patient had almost complete relief of symptoms within twenty-four hours and took his feedings without difficulty from the first postoperative day on. Subsequently, he has remained asymptomatic and is developing normally.

COMMENTS

Patients with anomalies of the great vessels may have airway and/or feeding problems. The onset of symptoms can occur at any time during the first year or so of life, and frequently are present at birth. The symptoms are obstructive in nature and result from compression of either the trachea and/or esophagus by the offending vessel or vessels.

The inital evaluation of any infant with these symptoms should prove the patency and function of the supraglottic airway and naso-oral pharynx. It is difficult to determine the exact nature of tracheal obstruction beyond the larynx by physical examination alone. The symptoms and manifestations are very similar regardless of the cause. However, a persistent expiratory stridor which is influenced by the position of the baby's head is significant and should be carefully evaluated. Foward flexion of the neck tends to pull a retroesophageal or retrotracheal aberrant vessel anteriorly, increasing the compression. In fact, the airway can be obliterated in some cases by forceful forward flexion of the neck. Many of these children will habitually lie on the abdomen with the head held back in hyperextension; in this position the trachea is stretched and straightened, and the aberrant vessel is pulled dorsally which relieves the obstruction to a greater or lesser extent.

Early roentgenographic examination is essential and should include a posterioanterior and lateral chest film and barium swallow. Occasionally a defect in the tracheal air column can be detected on a plain lateral film, but more often the barium swallow with posterioanterior and lateral views will be diagnostic. The size of the anomalous vessel, its relationships and the plane in which it lies can be determined from this study, making it possible to diagnose preoperatively nearly any of the several possibilities of vascular malformation. Laryngoscopy without sedation or anesthesia can demonstrate the normalcy of the supraglottic area, ruling out supralaryngeal webs, paralysis of the vocal cords, laryngeal tumors, etc. It does not help in making a diagnosis when the pathologic disorder lies distal to the vocal cords. Bronchoscopy, at best, is a dangerous maneuver in the very young infant and should be avoided. Only rarely is it necessary to introduce radiopaque material into the trachea in order to establish the diagnosis. In general, these more elaborate procedures should be avoided in view of the relative ease and reliability of making a diagnosis by simpler means.

There are many possible variations of mediastinal vascular malformations. Gross recognizes five principal categories (the double aortic arch, right aortic arch with a left ligamentum arteriosum, anomalous innominate artery, anomalous left common carotid artery and aberrant subclavian artery).

Although there are numerous configurations which the anomalous vessels may assume, they can be resolved into three basic patterns: (1) an aberrant vessel passing anterior to the trachea or esophagus compressing the structures from anterior to posterior; (2) an anomalous vessel passing posterior to the trachea and/or esophagus producing compression from behind; and (3) anomalous vessels which form a closed ring about the trachea and esophagus, usually compressing both structures.

Tracheal or esophageal obstruction as a result

of anomalies of the great vessels is best treated by division of the offending structure. Left anterolateral thoracotomy through the third intercostal space is the preferred incision. Subtotal thymectomy is routinely performed to improve the exposure. It is essential that the anomalous vessel or vessels be adequately visualized to determine the extent of surgery necessary to relieve the obstruction effectively.

When the vessel passes anterior to the trachea (i.e., an aberrant innominate artery) it may suffice to tack this vessel and/or the aortic arch to the posterior surface of the sternum to produce complete relief of the symptoms. When the mobility of the aortic arch significantly influences the operative result, the ligamentum arteriosum should be divided. If a complete ring is present it must be broken in order to relieve the obstruction. In the case of a double aortic arch, care must be exercised in determining the component of the arch that carries the largest volume of blood. Occasionally one of the arches will be internally coarctated to a severe degree, a fact that may not be detectable from the outward appearance of the vessel. A trial occlusion of each arch is recommended to determine which vessel will best meet the demands of the circulation.

When the anomalous vessel is one of the subclavian arteries, it may be divided with impunity. A right aberrant retroesophageal subclavian artery, such as in the case presented, represents one of the more common of the vascular anomalies. The vessel arises from the posterior aspect of the descending portion of the aortic arch and passes upward to the right, usually behind the esophagus. This vessel must be divided and the perivascular sheath completely dissected out. Failure to do this leaves a band of fibrous tissue behind which will scar down and reproduce the obstructive effect of the vessel itself.

Surgical division of a vascular ring will not produce an immediate cure in all cases. Many of these infants are prone to develop pronounced symptoms of tracheal obstruction due to edema in the postoperative period. A deformity of the tracheal cartilages produced by the compression of the anomalous vessels will persist postoperatively for varying periods, and the child will show symptoms of respiratory obstruction for days or even weeks after the operation.

During the first twenty-four hours after surgery it is best that these children be kept in a moist atmosphere such as that provided by a croup tent. Those infants who show no evidence of obstruction of the airway may be fed clear liquids with caution as soon as twelve hours after recovery from anesthesia. Usually, a normal intake may be resumed by the second or third postoperative day. However, the majority of these babies will have a significantly increased respiratory effort during the early postoperative period. This tends to increase the amount of inspired gastrointestinal air which may result in severe abdominal distention or acute gastric dilation in the face of postanesthetic diminution of intestinal motility. It is advisable to maintain constant nasogastric suction until the respiratory symptoms have subsided and good gastrointestinal peristalsis has returned.

While it is true that anomalous development of the great vessels in some instances does not produce symptoms or shorten the life span, many of these malformations are lethal and must be corrected at an early age. A high index of suspicion in regard to these lesions must be maintained by the physician examining an infant for respiratory or feeding difficulties. In most instances the physical findings plus a careful fluoroscopic and roentgenographic examination of the esophagus will be diagnostic. It is rarely necessary to resort to tracheography or tracheoscopy to establish the diagnosis, and often the lesion will not be detected by these maneuvers.

Once the diagnosis is made in the symptomatic patient, unnecessary delay in treatment to determine whether or not the infant will need surgery is to be discouraged. In general, the symptoms are progressive and the hazards of aspiration pneumonia or occlusion of the airway are ever present. A high index of suspicion, accurate diagnosis and prompt surgical intervention are essential to the management of these lesions.

Esophageal Atresia and Imperforate Anus

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PATIENT J. M., a sixty-four hour old white male infant, was the first child of a healthy thirty-eight year old mother. The pregnancy had been uncomplicated; delivery was spontaneous and at term. The birth weight was 7 pounds, 9 ounces; crown to heel length was 44 cm. No external malformations were detected. Since birth, the child had an accumulation of mucus in the pharynx which required frequent suctioning. When oral feedings were started prompt regurgitation occurred with choking and cyanosis. Oxygen was administered on two occasions to alleviate the respiratory distress. The baby was circumcised on the second day. On the third day he was transferred to The Children's Hospital for surgery because he had passed no meconium and the anus had been found to be imperforate.

PHYSICAL EXAMINATION

The patient was a mildly icteric, newborn male infant with a tense, distended abdomen. Skin turgor was fair. His weight was 6 pounds, 15 ounces. His axillary temperature was 97°F., pulse 140, respirations 64 and blood pressure 80/40 mm. Hg. There were diminished breath sounds over the apex of the right chest and on both bases. The abdomen was tympanitic and greatly distended with visible bowel patterning. No abdominal masses were palpable and bowel sounds were absent. The scrotum was bifid and contained both testes. The penis was circumcised. No anal opening or dimple was present, but the anal sphincter was detectable in normal position by skin stimulation. Because of the abdominal distention an attempt was made to introduce a three-hole No. 10 French nasogastric tube into the stomach. The catheter met an obstruction in the esophagus at approximately 12 cm. from the tip of the nose. The diagnosis of esophageal atresia coexistent with an imperforate anus was made.

LABORATORY DATA

To demonstrate the level of the upper esophageal pouch, 0.5 ml. of Lipiodol® was instilled through the catheter. Posteroanterior and lateral roentgenograms of the chest showed it to be at the level of the third thoracic vertebra. An aspiration type pneumonitis was seen in both lung bases and the right upper lobe. Films of the abdomen taken with the infant in recumbent and erect positions showed greatly distended loops of bowel. Films of the abdomen in the "head-down" position showed the blind distal end of the rectal pouch to be 2.5 cm. from the anal skin. A lateral view in the same position showed a small amount of air within the bladder which suggested a rectovesical fistula. Roentgenograms also revealed a bifid right eleventh rib, a hemivertebra in the lower thoracic region and a fractured left clavicle. The urine contained particles with the appearance of meconium. Examination of the blood revealed a hemoglobin of 19.4 gm. per 100 ml. and a white cell count of 4,700 per cu. mm. with 38 per cent neutrophils, 41 per cent band forms, 1 per cent eosinophils and 20 per cent lymphocytes. The bilirubin was 14.4 mg. per cent total and 13.5 mg. per cent indirect.

EARLY MANAGEMENT

The infant was placed with the head elevated 20 degrees in an incubator with a highly humidified atmosphere. The upper esophageal pouch was kept empty by constant suction of the nasoesophageal catheter. Oropharyngeal suction was also performed intermittently. A transfusion of 60 ml. of whole blood and an intravenous infusion of 50 ml. of 5 per cent dextrose in quarter-strength saline, at a rate of 10 ml. per hour, were administered intra-

venously through a polyethylene catheter inserted in the greater saphenous vein at the ankle. Crystalline penicillin was added to the intravenous solution. Constant nursing care and recording of respiratory rate every fifteen minutes was ordered. After five hours of this preoperative management, the baby was considered ready for surgery. The preoperative diagnosis was imperforate anus with rectovesical fistula, esophageal atresia with tracheoesophageal fistula and physiologic jaundice of the newborn. The sequence of the operative procedures to be done was sigmoid colostomy, gastrostomy, division of tracheoesophageal fistula and primary esophageal anastomosis.

SURGERY

Endotracheal intubation was done with the child awake. An Ayres tube was used to administer ether and oxygen for the abdominal part of the operation and cyclopropane was administered for the thoracic part. The baby's temperature was maintained at 94°F. with the aid of a circulating water mattress. Pulse rate at the beginning of the procedure was 200, blood pressure 76/38 mm. Hg.

The patient was placed in the supine position, and the abdomen was prepared and draped into two separate fields—the upper and the lower left quadrants. Sigmoid colostomy was performed through a transverse incision on the left lower quadrant. A distended loop of sigmoid was brought out over a glass rod and the proximal limb was decompressed with a catheter. A Stamm type gastrostomy was performed through a short left upper quadrant paramedian incision using a No. 14 soft rubber catheter.

The child was then turned to the left lateral position with the right side uppermost. The area was prepared and draped again. A new set of instruments was used and the surgical team changed their gowns and gloves. A posterolateral thoracotomy incision was made. The chest was entered through the bed of the fourth rib and dissection was performed extrapleurally. The fistula was divided and the tracheal wall was sutured. The child's condition was good, with a pulse rate of 140 and a blood pressure of 80/40 mm. Hg. The operation was completed in one stage by a two-layer end-to-end anastomosis of the esophagus. The child was awake at the conclusion of the procedure, and the estimated blood loss, which had been gradually replaced, was 200 ml.

Postoperatively the child was placed in a warm, oxygenated and humidified incubator, and he received constant nursing care. The head was kept elevated 20 degrees. Frequent suctioning of the oropharynx was done with a soft, two-hole rubber catheter which was marked 10 cm. from the tip so that it would not come in contact with the anastomotic suture line. Antibiotics and intravenous fluids were continued. During the following five days, the jaundice gradually subsided. Gastrostomy feedings were started on the second day, at which time the intravenous catheter was removed. The loop colostomy was divided on the fifth day and the proximal stoma was dilated daily thereafter. Esophagrams on the tenth day showed an anastomosis of a good calibre. Oral feedings were then started to gradually replace the gastrostomy feedings. The gastrostomy tube was removed on the twenty-second day. His course was essentially afebrile and the weight gain gradual. The child was discharged from the hospital. Definitive surgery for the imperforate anus was planned for when the child attained a weight of about 20 pounds.

COMMENTS

This paper describes the management of a newborn with two major congenital anomalies, both complicated by later diagnosis. The imperforate anus was not noted until the third day of life although the child was circumcised on the second day. The excessive pharyngeal mucus and regurgitation, choking and cyanosis after feedings should have pointed to the diagnosis of the tracheoesophageal anomaly. This could have been easily confirmed by catheter intubation of the esophagus.

Delay in the diagnosis of tracheoesophageal fistulas results in widespread pneumonitis which greatly increases the mortality. This pneumonitis is caused by aspiration of saliva and feedings from the proximal blind esophageal pouch and by regurgitation of acid gastric juices via the lower esophageal segment. These two mechanisms are minimized by continuous aspiration of the upper pouch and by the semi-sitting position, respectively.

There is a high incidence of prematurity in babies with esophageal atresia. The fact that this child was born at full term and weighed

almost 7 pounds was an important factor in his favorable outcome despite the extensive pneumonitis.

The number of hours needed to prepare these patients adequately for surgery depends upon their degree of hydration. Five hours' preoperative preparation for restoration of blood volume and administration of antibiotics was sufficient in this case. More than ten or twelve hours is seldom needed. The incidence of malformations of the anus or rectum associated with atresia of the esophagus is about 10 per cent. Conversely, in cases of imperforate anus in which marked gaseous distention of the abdomen develops in the first two days of life, an associated tracheoesophageal fistula may be suspected. Early diagnosis reduces the mortality in patients with either of these anomalies.

Surgery Court Cases

HOWARD NEWCOMB MORSE,* *Atlanta, Georgia*

CLARY VS. CHRISTIANSEN

Court of Appeals of Obio

83 N. E. 2d 644

The surgeon operated upon the patient to remove an abscess from the lung. To do this, it was necessary to pack the pleural cavity with paraffin to prevent the infection from spreading when the abscess was opened. A second operation was performed to drain the abscess and remove the paraffin.

In performing the second operation either of two types of electrical machines could be used, requiring different technics. The surgeon instructed the hospital attendants to prepare an operating room and supply a Davis Bovie machine. When he arrived at the assigned room, he found the Davis Bovie machine was there. He proceeded to test it, and found that it was in good working condition.

The surgeon then went to the scrub room to prepare to perform the operation. After the necessary preparations were made, he immediately went back to the operating room, where he found the patient draped for the operation. The electrical machine was in position but, as usual, was hidden from the view of the surgeon by a screen between it and the operating table, except for the attachments used by him in performing the operation.

While the surgeon was in the scrub room, attendants of the hospital had removed the Davis Bovie machine and substituted a Fisher machine. The surgeon was not informed of this substitution and proceeded with the operation as though with a Davis Bovie machine. The result was that the patient received a severe third degree burn on the outer surface of the right thigh, where his leg rested on the electrode of the machine.

The patient filed an action in the Court of Common Pleas of Hamilton County, Ohio, against the surgeon for malpractice. The surgeon contended that he knew nothing of the substitution of the machine until long after the operation and after he was sued. The patient pointed out differences in the two machines and asserted that these differences were sufficient to have caused a reasonably prudent surgeon, familiar with both types, to have noticed the differences. A jury returned a verdict in favor of the surgeon and the court entered judgment accordingly. The patient appealed.

The Court of Appeals of Ohio affirmed the decision of the lower court. The Court of Appeals stated: "The evidence, however, of the screening of the machine . . . certainly prevented the court from charging the defendant with personal knowledge as a matter of law, and required that the issue be submitted to the jury."

BRADSHAW VS. WILSON

Court of Appeals of Obio

94 N. E. 2d 706

On June 19, the patient sustained a spiral comminuted fracture of the humerus of the right arm just above the elbow. The next day she was admitted to Mercy Hospital in Toledo, Ohio. The surgeon was employed, on the advice of her physician, to reduce the fracture and

* Counsellor at Law of the Supreme Court of the United States of America.

attend her. After a roentgenogram was made, the surgeon proceeded to reduce the fracture by an open operation, placing two screws in the broken bones and a cast on the arm. The next day another roentgenogram was made.

Shortly after this, infection developed in the wound and the surgeon cut a hole in the cast in the area of the operation to enable the wound to drain and be treated. A sinus drainage also developed. At that time the surgeon told the patient that her arm was getting along "all right."

After about a month and while the wound was still draining, the surgeon permitted her to go home. However, under his directions, she went to his office, where he continued to dress the wound. He then told her to go to the outpatient clinic of Mercy Hospital, where she went daily for two weeks. When the surgeon returned from a vacation she returned to the hospital, where she stayed another month under the care of the surgeon and his assistant. The wound in her arm was still draining.

After the second month in the hospital under the surgeon's care, she was again permitted to go home, but returned to the outpatient clinic where the surgeon's assistant dressed the arm. During that time one of the two screws came out into the dressing. Through all this the surgeon was in charge and directed the care given the patient. The patient suffered severe pain in her arm and hand during this time. On November 25, the patient was transferred to Maumee Valley Hospital. The surgeon's assistant said that this was done "as an economic factor."

With this change, a new period in the treatment of the patient's arm began. Two other surgeons took over her case. They took roentgenograms which showed that no union of the bone had taken place and the wound was still draining. She was given frequent doses of penicillin and sulfamerazine until December 12, when the new surgeons operated upon the arm. The purpose of the operation was to remove "a piece of dead bone and a screw from the area of the fracture." The screw was the second one which had been put into the bone by the first surgeon on June 20. "It was an isolated screw, not holding anything." In February of the following year, the new surgeons performed another operation "to bone-graft the fracture, repair the radial nerve." After these operations the drainage stopped, and in a month the patient was able to use her arm.

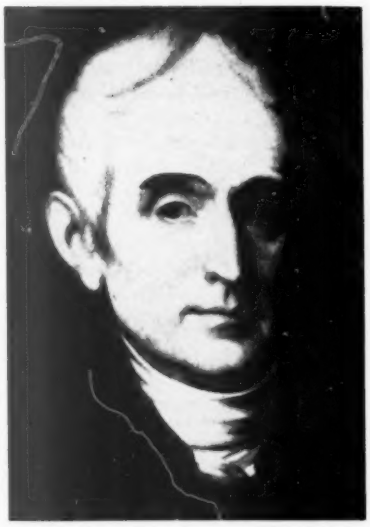
The patient filed an action in the Court of Common Pleas of Lucas County, Ohio, against the first surgeon for damages alleged to have resulted to her from his malpractice. The court entered judgment in favor of the surgeon, and the patient appealed.

The Court of Appeals of Ohio reversed the decision of the lower court. The Court of Appeals held that the following two facts proved negligence on the part of the first surgeon: (1) the first surgeon permitted a piece of dead bone from the fracture to remain in the flesh and cause drainage from the wound for months; and (2) the fracture did not show evidence of healing for five months, but when it was treated by the other surgeons it was reduced in two months.

Our Surgical Heritage

D. P. HALL, M.D., *Surgical Department, University of Louisville, Louisville, Kentucky*

UNITED STATES OF AMERICA



WRIGHT POST

WRIGHT POST was born on February 18, 1766, at North Hempstead, Long Island. His father was Jocham Post and his mother was the daughter of Benjamin Wright.

It was said of Post that "he was remarkably quiet, amiable and accommodating but resolute and firm in his purposes and active both mentally and physically. He was never known to engage in mischievous sports or dangerous intrigues and his mother was heard to say his conduct never afforded her uneasiness." Post was tall, handsome, dressed stylishly and wore his hair powdered and in a queue. He read little, was averse to writing and was not brilliant in speaking.

At the age of fifteen, Wright Post began the study of medicine under Richard Bayley, one of the most celebrated surgeons in New York. After four years of diligent work with Dr. Bayley, he went to London where he became a pupil of John Sheldon who was a renowned teacher of anatomy and surgery. He spent about two and a half years with Mr. Sheldon and

seems to have absorbed most of his spirit and zeal for surgery from this teacher.

On his return from England, he began the active practice of surgery and delivered lectures on anatomy at the New York Hospital. In 1790 Post married Dr. Bayley's daughter, and became associated in the practice of surgery with his father-in-law shortly thereafter. In 1792 Wright Post was appointed professor of surgery at Columbia College. A short time after this he left for London to pursue further study and to procure material for a medical museum.

The Regents of the University of the State of New York conferred upon Post the honorary degree of Doctor of Medicine in April 1814. He was appointed a trustee of Columbia College in 1816 and remained in this position until his death. For thirty-five years Post was one of the surgeons at and consulting surgeon to the New York Hospital. His many accomplishments in the world of surgery brought him practice and fame.

Aside from his teaching, he probably gained most fame as the first doctor in America to successfully tie the femoral artery for popliteal aneurysm. In 1813 he tied the external illiac artery for an inguinal aneurysm. This was the second such operation in the United States. His greatest accomplishment in surgery was tying the subclavian artery (1817) for brachial aneurysm.

Wright Post died on June 14, 1828, at Throggs Neck in the Bronx, New York. "It is excellent, to be first in any line, and doubly excellent if the line is great."

EUROPE

LORENZ HEISTER

LORENZ HEISTER was born in 1683 at Frankfurt am Main, Germany. His father was a duly accepted burgher of Frankfurt, which was considered quite an honor, as well as an innkeeper, and both parents possessed distinguishing traits not found in many people of the time. He inherited a remarkable degree of intelligence and application, and also he received sympathetic recognition of his qualities from them. Heister became a pupil at an early age in the Latin School in Frankfurt and was noted for his unusual aptitude and zeal in the study of the humanities. During his boyhood Heister saw the waning of the terrible power of the Grand Turk. The events of the wars of the Spanish succession showed him the rapid decline of medievalism in war, science and statesmanship. It must be remembered that Europe was just recovering from the wars of the Reformation at this time, and all this must have had a great bearing on his thinking.

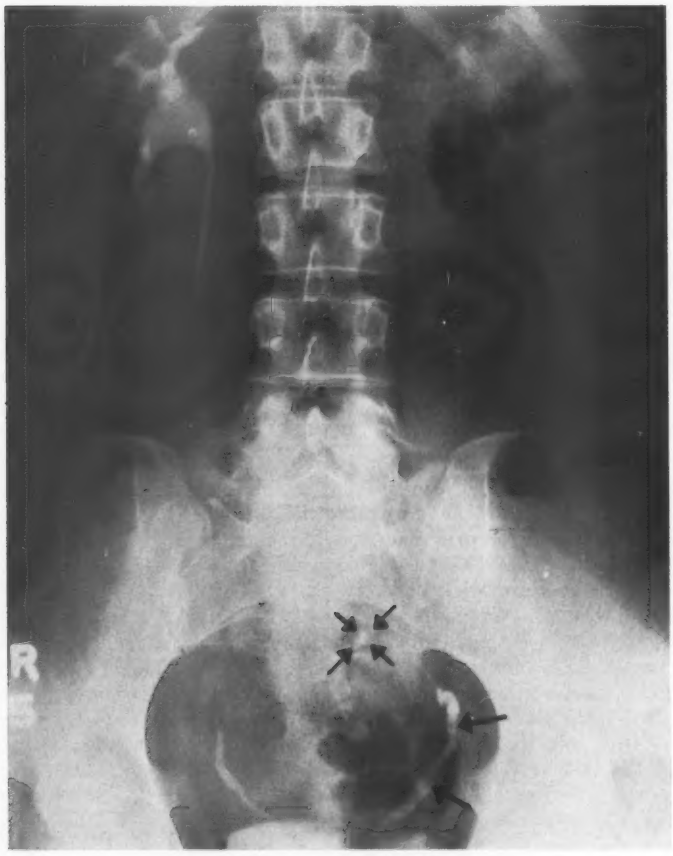
Heister was graduated from the Latin School and in 1709, in his nineteenth year, he started the study of medicine at the University of Giessen. As was the habit of German students of his time, he migrated to Leyden in the Netherlands where he became an assistant to Ruysch. He was graduated in medicine at Hardewick on May 31, 1708, and was appointed chief surgeon of the army of the Netherlands. Satisfied with a short sojourn in the army, he joined the faculty of the University of Altorf, and it was at this time that he married the daughter of Professor Hildebrandt. From this union twelve children were born, two of whom survived him. In 1720 he accepted the professorship of anatomy and surgery at the University of Helmstaedt, and the School of Surgery of Helmstaedt was raised from a position of obscurity to that of first rank due to his influence. It attracted many students from all parts of the world.

Heister was probably best known for his description of the valve of Heister and Heister's diverticulum (external jugular sinus). He was undoubtedly the founder of scientific surgery in Germany, and his published book on surgery (1739) was both modern and comprehensive. Lorenz Heister died on April 18, 1758. He was both diligent and intelligent.

The Diagnostic Corner

SIDNEY W. NELSON, M.D., *Department of Radiology, The Ohio State University, Columbus, Ohio*

An interesting case illustrating the advisability of not removing pelvic masses until their nature has been clarified by appropriate diagnostic procedures.



THIS twenty-two year old white woman had been well until three years prior to her admission, at which time she noted crampy pain in the right lower quadrant, chills and fever radiating to her right flank. She was hospitalized for four days and the pain subsided. Three years prior to admission the patient had a similar episode which ended after three days of bedrest at home. One month prior to admission the patient had pain in the right lower quadrant, pain in the right flank, chills and fever. She was hospitalized, and appendectomy was performed. At the time of appendectomy a retroperitoneal pelvic mass was seen. Her postoperative course after the appendectomy was uneventful, although she continued to have some pain in the right flank and the right lower quadrant. Because of the retroperitoneal mass her physician referred her to the Ohio State University Hospital on March 4, 1956.

Physical examination on admission was normal except for minimal tenderness in the right lower quadrant and a midline healing scar at the site of the previous appendectomy. Pelvic examination was normal, although the fundus of the uterus could not be clearly palpated because of the discomfort on palpating the recent appendectomy scar. All routine laboratory studies were within normal limits. Gastrointestinal roentgenograms, barium enema and cholecystogram demonstrated no abnormality. An intravenous pyelogram was performed which showed a normal right urinary tract. The left urinary tract was not visualized except for the lower 4 inches of the left ureter (arrows, opposite). One small collection of contrast material was seen overlying the left side of the sacrum. *What is your diagnosis?*

Please turn page for answer

Diagnosis: Ectopic presacral kidney, left.

The surgeon who performed the appendectomy was very wise in not attempting to remove the retroperitoneal mass which had not been suspected preoperatively. Although it would be unfortunate to unknowingly remove a normal ectopic kidney in the presence of a remaining normal kidney, it would indeed be disastrous to remove the ectopic kidney if it were the only kidney the patient had. There have been numerous reports in the literature describing patients who have only one kdiney which, furthermore, is in an ectopic location. Therefore, before the removal of any retroperitoneal mass of unknown etiology, it is extremely wise to make certain that the mass is not an ectopic kidney. Intravenous pyelography is an excellent procedure to use in the study of any retroperitoneal tumor.

The intravenous pyelogram (see page 148) shows filling of one of the calyces anterior to the sacrum (arrows). It should be remembered that when intravenous pyelography is performed in adults, reflux flow of contrast material from the urinary bladder into a normal-appearing lower ureter is almost never seen. We should always assume that the contrast material in the ureters on intravenous pyelography arrived there via excretion from the kidney. In the case presented herein, the lower left ureter is seen clearly, and since the left kidney is not seen in its normal position, a diligent search for the kidney should be made elsewhere, particularly in the presacral area near the proximal end of the visualized lower left ureter. The retrograde study (opposite) clearly showed the calyceal system of the presacral ectopic left kidney.

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Book Reviews

An Atlas of Normal Radiographic Anatomy. By Isadore Meschan, M.D., with the assistance of R. M. F. Farrer-Meschan, M.D. Second edition, 759 pages. W. B. Saunders Co. Philadelphia, 1959. *$16.00.*

The author has made many improvements in the second edition of this authoritative text. The demonstration of skeletal anatomy continues to be an outstanding feature, with many technics described for measuring deviations from normal. The chapter on growth and development is particularly well done, especially with reference to the pelvis and dislocated hips in children. The anatomy of the brain, as demonstrated by ventriculographic and arteriographic methods, is depicted in a very understandable manner. The author is an expert in the field of spinal anatomy, and this section will be very useful to all physicians dealing with "back problems." There are also outstanding new sections dealing with angiocardiographic and angiographic demonstrations of the anatomy of the circulatory system. The description of phlebography of the lower extremities is clearly given. The sections on bronchographic and gastrointestinal anatomy are very complete and accurate.

There are so many outstanding features of this book that it is difficult to find points for adverse criticism. The section dealing with x-ray protection is necessarily brief, and one wonders whether it is wise to attempt to cover such a subject, albeit an important one, in a book on anatomy. Some of the illustrations might have been improved by the use of reproductions of x-ray films of excellent quality, rather than to have resorted to the Log-etronic method of reproducing the x-rays. No mention is made of the retrograde aortographic studies of the anatomy of the aortic valve regions and coronary arterial circulation.

The excellent features of the book make it a "must" in the library of anatomy teachers, radiologists and other physicians who have to deal with anatomy as depicted in radiographs. The scope of anatomic material included will make this a daily reference in radiology departments where residents are being trained. The book will also be of great value to all physicians who must have a knowledge of radiographic anatomy in their use of diagnostic x-ray films.

SIDNEY W. NELSON, M.D.

A Synopsis of Anaesthesia. By J. Alfred Lee, M.R.C.S., L.R.C.P., M.M.S.A., F.F.A.R.C.S., D.A. Fourth edition, 616 pages. Williams & Wilkins Co. Baltimore, 1959. *$6.50.*

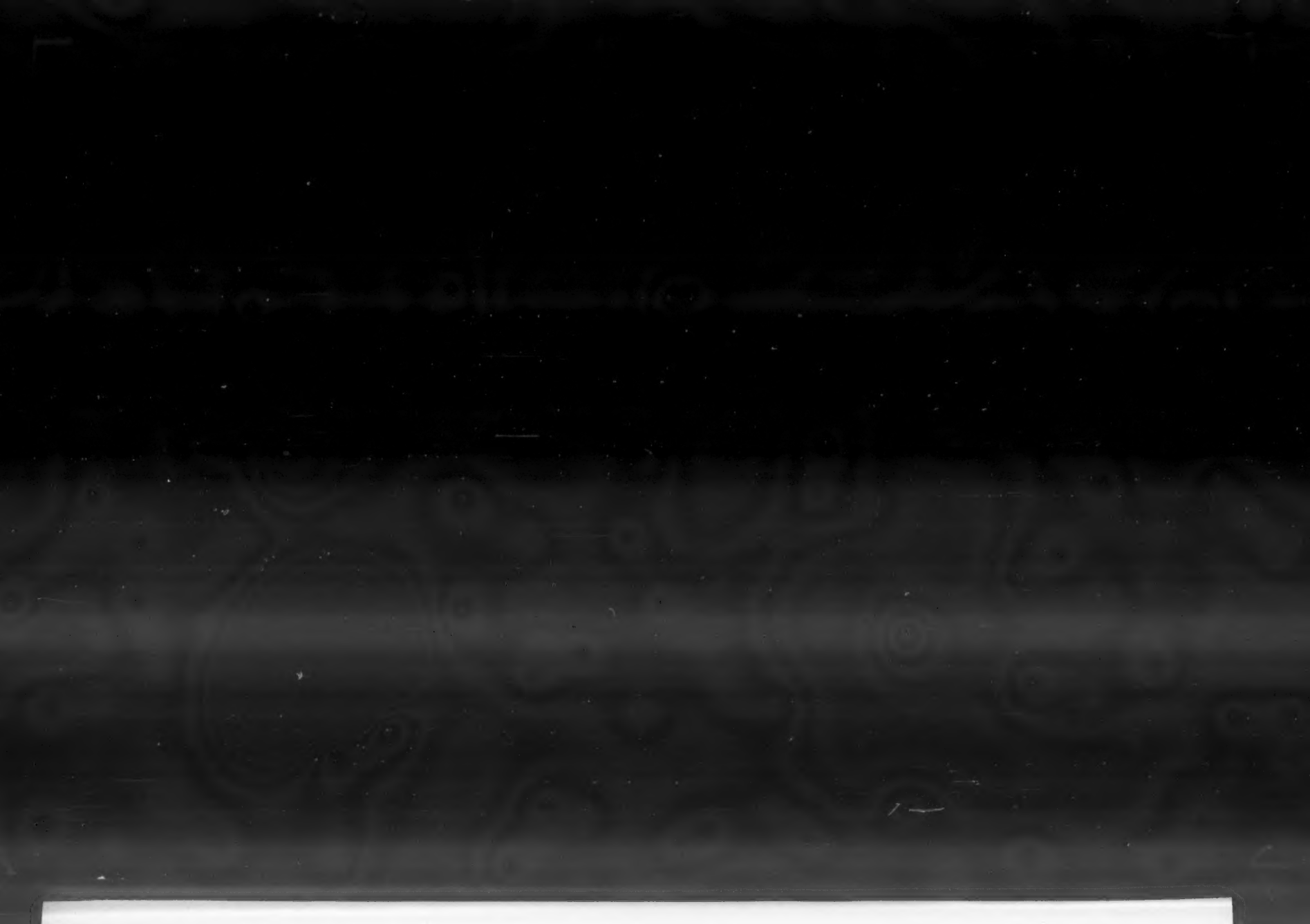
Previous editions of this book have always been considered a necessary addition to the library of the anesthesiologist. With this fourth edition, the anesthesiologist now has available a book which is up to date and from which information can be obtained rapidly. The references have been revised to the present and the book is well indexed.

The text can be readily recommended not only to the practicing anesthesiologist but also to the surgical profession since it incorporates all the known methods and technics employed in anesthesia. Included also are the various complications resulting from surgical intervention and anesthesia. Methods of treating these complications are well presented.

WILLIAM HAMELBERG, M.D.

Ciba Foundation Symposium on Carcinogenesis: Mechanisms of Action. Edited by G. E. W. Wolstenholme, M.B., B.C.H. and Maeve O'Connor, B.SC. 336 pages. Little, Brown & Co. Boston, 1959. *$9.50.*

The general medical reader finds the subject of carcinogenesis a difficult, detailed and controversial one, and he is somewhat hard-pressed to fully appreciate what is presented. In the Ciba Foundation Symposium on this subject, good editing has produced an excellent choice of speakers and subject matter and informative presentations. It is a classic study in carcinogenesis progressing from a discussion of present theories through multiple research problems to closing remarks and a concise summary.

The reader will appreciate the stress on investigations into the correlation of everyday life to carcinogenesis.

FOSTER MARSHALL, M.D.